

sov/108-13-2-8/15-13/5

AUTHOR: Grinberg, A. A.

TITLE: On the Theory of the Transfer Characteristic of a Triode-Transistor (K teorii perekhodnoy kharakteristiki poluprovodnikovogo trioda)

PERIODICAL: Radiotekhnika, 1958, Vol. 13, Nr 2, pp. 51 - 53 (USSR)
Received: April 25, 1958

ABSTRACT: Here the transfer characteristics of a triode transistor are under current control and with different wiring schemes are obtained. The analytical form of the transfer characteristic gives the possibility to consider the collector capacity and the load resistance of the triode. At first the transition characteristic of a triode in a scheme with a grounded and current-controlled basis is investigated. Laplace's representation of the current transfer characteristic $g(t)$... equation (1) obtained in Reference 1 is put down, which corresponds to the deltaform $[\delta(t)]$ emitter current. The consideration of the collector capacity C_c and the finite load resistance R_{load} with the help of the equivalent scheme with small signals for

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SOV/108-13-2-8/15-15/5

On the Theory of the Transfer. Characteristics of a Triode Transistor

the collector circuit leads to equation (7). By application of the multiplication theorem of operation calculus the transfer characteristic $G(t)$ of the triode ... equation (8), which takes the influence of the collector capacity and of the load resistance into consideration, is obtained. $G(t)$ is the exact solution of the problem investigated by A. V. Ayrapetyanets and S. M. Ryvkin (Reference 5). There are 5 references, 5 of which are Soviet.

SUBMITTED: March 25, 1957

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GRINBERG, A.A.

Calculation of transients in semiconductor triodes. Fiz.tver.tela
(MIRA 12:4)
1 no.1:31-43 Ja '59.
(Transistors) (Transients (Electricity))

24.7700
24(3), 24(6)

AUTHORS:

Ryvkin, S. M., Ivanov, Yu. L., Grinberg, A. A., Novikov, S. R.,
Potekhina, N. D.

67390

SOV/181-1-9-8/31

TITLE:

A New Longitudinal Magnetostriiction Effect and Its Application to the Determination of the Ratio Between the Concentrations of Heavy and Light Holes

PERIODICAL:

Fizika tverdogo tela, 1959, Vol 1, Nr 9, pp 1372 - 1375 (USSR)

ABSTRACT:

When investigating the diffusion of the nonequilibrium carrier in the magnetic field, the appearance of electrical fields is usually studied (e.g. the photomagnetic Kikoin-Noskov effect). The present paper offers the results obtained from an investigation of the concentration distribution of the minority carrier in the magnetic field, and in particular, the results of an investigation of the longitudinal magnetostriiction effect in the longitudinal magnetic field. A plane-parallel semiconductor plate was arranged perpendicularly to a homogenous magnetic field. On the plate, a point light probe exactly faced a point collector. The injected nonequilibrium carriers diffused through the plate and the collector determined the concentration of the minority carrier. The concentration

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A New Longitudinal Magnetostriction Effect and Its Application to the Determination of the Ratio Between the Concentrations of Heavy and Light Holes SOV/181-1-9-8/31

recorded thereby increased with H . Figure 1 shows a schematic representation of the measuring arrangement, a description of which is given. Theoretically, one obtains for the concentration of the injected carrier on the z-axis

$$(\vec{H} \parallel z) : \Delta n_H = \frac{i_0 \beta e}{2 \pi D_n z I(\gamma_v)} , \text{ where } i_0 \beta \text{ is the electron-hole pair production rate, } D_n \text{ the diffusion length, } D_n \text{ the electron diffusion coefficient. Figure 2 shows the result obtained by an attempt of experimentally verifying this formula for electron injection into hole-type germanium. The best agreement is obtained with a microscopic drift mobility of the electrons, } \mu_n^0 = 3650 \text{ cm}^2/\text{v.sec. When investigating the hole diffusion in n-type germanium, a considerable divergence between theory and experiment is observed, which, however, can be explained when taking into account the existence of}$$

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A New Longitudinal Magnetostriiction Effect and Its SOV/181-1-9-8/31
Application to the Determination of the Ratio Between the Concentrations
of Heavy and Light Holes

heavy and light holes. The theoretical curve drawn for this case nicely describes the experimental results. The concentration ratio between heavy and light holes is deduced from measuring results as being 57; this value approaches the result (50.0) obtained by an other way (Ref 1). There are 2 figures and 2 references.

SUBMITTED: March 7, 1959

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Card 3/3

J. P. B., and Phys-Math Sci -- (Alt) "Investigation of the physical processes
associated with the unbalanced currents in cylindrical waveguides",
Proc. IRE, 1940, 18 (1) (Vassiliev Institute under I. V. Kurchatov of the Academy of
Sciences SSSR)
(SL, 1-10, 102)

S/181/60/002/01/29/035
B008/B014

24.7900

AUTHOR:

Grinberg, A. A.

TITLE:

Theory of the Anisotropic Photomagnetic Effect²¹ in Germanium^{v1}

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 1, pp. 153-156

TEXT: The article under review deals with the photomagnetic effect discovered and studied by I. K. Kikoin and Yu. A. Bykovskiy (Refs. 1-3). In contrast to the ordinary photomagnetic effect, the sign of this effect does not change with changing direction of the magnetic field. It is described as follows: An electric field is generated in an illuminated sample located in a magnetic field that forms a certain angle α with the illuminated surface. This field is generated not only in the direction corresponding to the ordinary photomagnetic effect (according to Kikoin - Noskov) but also in a direction perpendicular to the former. Studies of the even (quadratic) effect on germanium have shown (Ref. 3) that the formula holding for the ordinary photomagnetic effect is not applicable to anisotropic samples. Here, the effect is non-zero even at $\alpha = 0$. *V*

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Theory of the Anisotropic Photomagnetic Effect in Germanium

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B008/B014

The author suggests another mechanism for the development of this effect. It is related to the anisotropic nature of the conductivity of the sample, which arises in consequence of the magnetic field. When the sample is illuminated in the presence of a magnetic field, the direction of the ambipolar current flux of the p-n pairs deviates from the direction of the arising concentration gradient. This is ascribed to the anisotropic nature of conductivity. For this reason, there is a non-zero component of the ambipolar flux in the direction of the magnetic field, though the magnetic field lies in a plane with the illuminated surface of the sample. This component is not caused by the "repeated" deviation but by the effect of the change in resistivity within the magnetic field. The authors believe that this mechanism offers an explanation of the even anisotropic photomagnetic effect observed by Kikoin and Pykovskiy in n-type germanium. The illuminated surface of the latter coincides with the (111) plane. The calculation of this effect is given. The author thanks S. M. Ryvkin and S. R. Novikov for their discussion of the article under review. There are 1 figure and 7 references, 5 of which are Soviet.

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Theory of the Anisotropic Photomagnetic Effect S/181/60/002/01/29/035
in Germanium B008/B014

ASSOCIATION: Leningradskiy fiziko-tehnicheskiy institut AN SSSR
(Leningrad Institute of Physics and Technology of the
AS USSR)

SUBMITTED: May 26, 1959

4

Card 3/3

Grinberg, A. A.

S/181/60/002/05/09/041
B008/B058

AUTHOR: Grinberg, A. A.

TITLE: Photomagnetic Effect in Isotropic Semiconductors and Its Application for the Measurement of the Lifetime of Minority Carriers

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 5, pp. 836-847

TEXT: An equation for the current, with regard to two types of carrier with equal signs (holes), is derived from the kinetic equation with arbitrary dependence of the relaxation time on the energy. The photocurrent and the photomagnetic emf are determined for arbitrary magnetic fields by means of this equation within the range of the application of the solution of the classical equation of motion. The photomagnetic method of measuring the lifetime is investigated next, and equations for the determination of the lifetime on transitions to strong fields are derived. Moreover, a survey on studies carried out in this field is given in the paper, and the following persons are mentioned: B. Ya. Moyzhes, Yu. N. Obraztsov, I. K. Kikoin, Yu. A. Bykovskiy, A. G. Mironov, K. B. Tolpygo, G. Ye. Pikus, and A. I. Ansel'm. Fig. 1 shows the experimental setup for the measuring of

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Photomagnetic Effect in Isotropic Semiconductors S/181/60/002/05/09/041
and Its Application for the Measurement of the B008/B058
Lifetime of Minority Carriers

the photomagnetoelectric effect (Kikoin-Noskov effect). Fig. 2 shows the difference between the regular actual lifetime and that computed from formula (31) for various magnetic field strengths. The magnetic field extends along the Z-axis, and the exposed surface coincides with the area (XZ). The exposure is accomplished with light with a depth of penetration much smaller than the diffusion length of the disequilibrated carrier. Presuming that the sample be long as compared to its thickness, and that E_y does therefore not depend on x , it is found, according to the potential of the electric field, that E_y does not depend on y . The author finally expresses his gratitude to S. M. Ryvkin, Doctor of Physical and Mathematical Sciences. There are 2 figures and 35 references: 16 Soviet and 19 English.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR, Leningrad
(Institute of Physics and Technology AS USSR Leningrad)

SUBMITTED: August 5, 1959

Card 2/2

VC

Grinberg, A. A.

S/181/60/002/007/001/042
B006/B070

AUTHOR: Grinberg, A. A.

TITLE: A Theory of the Photomagnetic Effect in Anisotropic Cubic Crystals

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1361-1367

TEXT: The purpose of this work was to develop a theory of the photomagnetic effect of anisotropic cubic crystals in weak magnetic fields for an arbitrary orientation of the crystal. The first theory of this effect, a macroscopic theory, is by Yu. M. Kagan and Ya. A. Smorodinskiy (Ref. 14). It obtains the angular dependence of the anisotropic photomagnetic effect (the so-called Kikoin-Bykovskiy effect) in an approximately correct form. For the determination of the magnitude of the effect, it uses a phenomenological coefficient, which, however, can be calculated on the basis of the microscopic theory developed in the present work. First of all, equations are set up which determine the electric fields that appear on irradiating a plane-parallel plate of a semi-

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A Theory of the Photomagnetic Effect in
Anisotropic Cubic Crystals

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B006/B070

conductor placed in a magnetic field. The geometric relations of the experiments are shown in Fig. 1. These equations are then solved on the supposition that the dimensions of the sample are large compared to the diffusion length of the minority carriers (holes). Explicit expressions are given for the components of the electric field and the concentration of the minority carriers. These are valid for an arbitrary orientation of the crystal to the magnetic field. These results are then applied to some special cases. One application is made to the irradiation of the (111) plane; Fig. 2 shows the dependence of the field component E_2 on the angle α^0 obtained from formula (23), and the experimental angular dependences according to Ref. 3, the angle α^0 giving the direction of the magnetic field relative to the sample. Fig. 3 shows E_2 as function of φ for $\alpha^0 = 45^\circ$ and $H = 24,000$ oersteds, φ characterizing the directions of the coordinate axes with respect to the [111] direction. The experimental angular dependence (Fig. 3a) is again compared with the theoretical value (Fig. 3b). The other application of the theory is made to the case of the irradiation of the (110) plane, that is, Ox_3 lies in the [110] direction. Fig. 4 shows $E_2(\varphi)$ at $\alpha^0 = 45^\circ$. The theory of

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A Theory of the Photomagnetic Effect in
Anisotropic Cubic Crystals

S/181/60/002/007/001/042
B006/B070

anisotropy of the photomagnetic effect developed here is in good
agreement with the experimental results. There are 4 figures and 14
references; 11 Soviet and 3 US.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR Leningrad
(Institute of Physics and Technology of the AS USSR,
Leningrad)

SUBMITTED: December 21, 1959

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Card 3/3

Grinberg, A. A.

82544

S/181/60/002/007/024/042
B006/B060

24.7700

AUTHORS: Grinberg, A. A., Strokan, N. B.

TITLE: Influence of the Rate of Surface Recombination and of the Absorption Coefficient on the Transient Responses of Photodiodes

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1536-1541

TEXT: Photodiodes²⁵ are to this day known as the converters^b of light signals or radiation pulses to electric pulses with the least inertia; the study of the influence of various parameters on their inertia has a great practical importance. The present paper is a contribution to this problem. The authors obtained, theoretically, an expression for the transient response of a photodiode for arbitrary values of the surface recombination rate S and of the absorption coefficient k; the importance of considering finite S- and k values is discussed in the introduction. As the initial step for the formulation of the problem (which is treated as a one-dimensional one), the authors used a schematic representation of a photodiode as is shown by Fig. 1. With large k values, e.g., in the conversion of a step pulse

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Influence of the Rate of Surface Recombination S/181/60/002/007/024/042
and of the Absorption Coefficient on the Transient B006/B060
Responses of Photodiodes

(Δ -pulse) by a photodiode, distortions of two types occur: the pulse experiences a shift with time and a modification of the form. θ_1 (delay time) denotes the time from the beginning of excitation to the moment at which the current has attained 0.1 of its stationary value I_{st} ; θ_2 denotes the duration of the current growth in the interval $I_{st}[0.1; 0.7]$. The authors wanted to determine $\theta_1(k, S)$ and $\theta_2(k, S)$, and to find $I_{\Delta}(t)$ for a Δ -excitation pulse. First, the transient response is found for a δ pulse, by which it is possible to determine $I(t)$ by means of Duhamel's formula for various exciting pulse shapes. Formulas (5) and (9) are obtained for $I_{\delta}(t)$ and by means of them for some special cases the transient responses are calculated for $S=0$ and shown in Fig. 2. $I_{\Delta}(t)$ is given by formula (10). By means of these formulas, θ_1 and θ_2 can be determined as functions of kw ; Figs. 3 and 4 show these for various S values. (w characterizes the distance between the irradiated diode surface and p-n junction, cf. Fig.1). θ_1 shows the largest change in the transition range of uniform generation

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Influence of the Rate of Surface Recombination
and of the Absorption Coefficient on the
Transient Responses of Photodiodes

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B006/B060

($k_w \ll 1$) to a strong absorption ($k_w \gg 1$). In the range of $k_w \ll 1$, θ_1 practically does not depend on S . θ_2 is less dependent on k_w than θ_1 . $\theta = \theta_1 + \theta_2$, is basically determined by θ_1 ; θ drops with rising S and scarcely varies with k_w . It is stated in conclusion that the transient responses of photodiodes are only slightly influenced by S . Consequently, the formulas which are given for $S = 0$ can be used in practice, namely (11) for $I_g(t)$ and (12) for $T_{\text{r}}(t)$. The authors finally thank D. V. Tarkhin for his aid in the numerical calculations. There are 4 figures and 5 references.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR Leningrad
(Institute of Physics and Technology of the AS USSR,
Leningrad)

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SUBMITTED: December 21, 1959

Card 3/3

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82546

S/181/60/002/007/026/042
B006/060

24.7.700

AUTHORS:

Grinberg, A. A., Paritskiy, L. G., Ryvkin, S. M.

TITLE:

The Influence of Adhesion Levels in Semiconductors on the
Steady Photoconductivity and the Lifetime of the Minority
Carriers

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1545-1561

TEXT: The present bulky article deals with a comprehensive study of the influence exerted by adhesion levels introduced into a crystal upon the carrier recombination in the steady state (thus, upon τ_p , τ_n , and $\Delta\sigma$) taking place above other traps located in the forbidden band. The study is extended to cover the influence of filling of adhesion levels on the dependence of τ_n and τ_p on temperature and light intensity. In the introduction, the authors discuss a number of relevant publications. In the first section of the paper, the influence of adhesion levels on τ_n and τ_p in the steady state is qualitatively examined by means of an example

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The Influence of Adhesion Levels in Semiconductors on the Steady Photoconductivity and the Lifetime of the Minority Carriers

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B006/B060

of a high injection level. This is done on the model of a semiconductor in whose forbidden band there exist two types of local levels with sharply differing properties (Fig. 1): the S levels are assumed to be traps for the minority electrons from the conduction band and the holes from the valency band, i.e., they are recombination centers for the light-produced minority charges. The M levels are, due to electron exchange, connected with the conduction band (the electron exchange with the valency band is forbidden), and therefore they are adhesion levels for the electrons. It is shown that the electron and hole concentrations in the S centers are closely related to the electron and hole concentrations in the bands. E. g., if the electron concentration in the conduction band is changed anyhow, the electron lifetime $\tau_n = 1/\gamma_n p_s$ in this band is decreased, and the hole lifetime $\tau_p = 1/\gamma_p n_s$ in the valency band grows. This is the sense in which the introduction of adhesion levels acts. (γ_n and γ_p are the trapping factors; n_s and p_s the electron and hole concentrations in the S centers; $n_s + p_s = S$, the concentration of the recombination centers). In the following

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The Influence of Adhesion Levels in
Semiconductors on the Steady Photoconductivity
and the Lifetime of the Minority Carriers

sections of the paper the authors first examine in a general way the influence exerted by adhesion levels in the case of a high injection level at a low concentration of the recombination centers, and then the same is done for a semiconductor with two types of injection levels. In this semiconductor the forbidden band contains, besides the recombination centers S and the adhesion levels M for the electrons, adhesion levels L for the holes from the valency band (Fig. 7). Section 4 again treats, for a semiconductor with one adhesion level in the forbidden band, the case of a high injection level, but at a high concentration of the recombination centers S. Finally, section 5 deals with the case of a low injection level at an arbitrary concentration of the recombination centers. Here, the Fermi quasi-levels of electrons and holes practically coincide, and the traps may be classified into adhesion levels and recombination centers only on the basis of the various trapping cross sections. (5.9) and (5.10) are first generally derived for τ_n and τ_p ; for $M = 0$ they go over to (5.11). The latter formulas are then further treated for the special cases of an n-type and a p-type semiconductor.

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The Influence of Adhesion Levels in
Semiconductors on the Steady Photoconductivity
and the Lifetime of the Minority Carriers

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B006/B060

S. G. Kalashnikov is mentioned. There are 10 figures and 19 references:
5 Soviet, 9 US, and 3 German.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR Leningrad
(Institute of Physics and Technology of the AS USSR,
Leningrad)

SUBMITTED: November 27, 1959

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Card 4/4

86425

S/181/60/002/011/009/042
B006/B056

24.2.200 (1138,1160,1162)

AUTHORS: Grinberg, A. A. and Novikov, S. R.

TITLE: Investigation of the Longitudinal and Transverse Magnetic Concentration Effects for the Purpose of Determining the Coefficients of Magnetic Conductivity in Anisotropic Crystals of Cubic Symmetry

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 11, pp. 2713 - 2717

TEXT: This paper is a continuation of two earlier ones, in which the authors investigated these problems for isotropic crystals and showed that the minority-carrier mobility may be determined also from the relations between the concentrations of heavy and light holes. As, however, directional dependence of the concentration effects in Ge was experimentally found, these effects are now investigated in anisotropic cubic crystals, proceeding from the phenomenological equation of Seitz $J = \sigma E + \alpha [EH] + \beta EH^2 + \gamma H(EH) + \delta TE$ for the charge current. T is a matrix with the elements $T_{ik} = H_i^2 \delta_{ik}$; σ_0 is the electrical conductivity at $H=0$; \checkmark

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86425

Investigation of the Longitudinal and Trans- S/181/60/002/011/009/042
verse Magnetic Concentration Effects for the B006/B056
Purpose of Determining the Coefficients of Magnetic Conductivity in
Anisotropic Crystals of Cubic Symmetry

α/σ_0 is the approximate Hall mobility; β/σ_0 , γ/σ_0 , and δ/σ_0 are material constants (in the case of isotropy, $\delta=0$ and $\beta+\gamma=0$). The coefficients may be experimentally determined by two methods mentioned in publications. The Seitz equation, however, holds only for weak fields up to about

$1.5 \cdot 10^3$ oersteds. As, however, no other equation taking the anisotropy of holes in Ge into account, and which is also valid for strong magnetic fields, the authors endeavor to obtain a solution by way of a compromise, which may be looked upon as a useful approximation also in the case of strong fields. This is possible for the cases in which $\vec{H} \parallel [111]$ and $\vec{H} \parallel [110]$. The coefficients β/σ , γ/σ , and δ/σ were determined on n-type Ge specimens with a resistivity of 2.3 and 10 ohm.cm by measurement of the longitudinal and transverse magnetic concentration effects

(at $H=1.1 \cdot 10^4$ oe). The results are given in a table and compared with the values obtained in Refs. 4 and 5. The following experimental values were obtained for the three parameters: $-1.4 \cdot 10^{-9}$, $0.6 \cdot 10^{-9}$, and $0.55 \cdot 10^{-9}$.

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Investigation of the Longitudinal and Transverse Magnetic Concentration Effects for the Purpose of Determining the Coefficients of Magnetic Conductivity in Anisotropic Crystals of Cubic Symmetry

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B006/B056

The corresponding values for heavy holes were found to be $-0.75 \cdot 10^{-9}$, 0, and $0.64 \cdot 10^{-9}$. S. M. Ryvkin, Doctor of Physical and Mathematical Sciences, is thanked for advice and interest. There are 1 figure, 1 table, and 6 references; 2 Soviet and 4 US.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR Leningrad (Institute of Physics and Technology of the AS USSR, Leningrad)

SUBMITTED: May 27, 1960

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Card 3/3

Grinberg, A. A.

81917
S/181/60/002/04/05/034
B002/B063

24.770°

AUTHORS:

Ryvkin, S. M., Grinberg, A. A., Ivanov, Yu. L.,
Novikov, S. R., Potekhina, N. D.

TITLE:

Investigation of the Diffusion of Minority Carriers in a
Magnetic Field

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 4, pp. 575-590

TEXT: The distribution of the concentration of minority carriers introduced into a magnetic field by "point" injection was theoretically and experimentally studied. A light spot was focused onto a germanium sheet cut out of a single crystal. The occurring emf was measured by means of an JB-9 (LV-9) tube voltmeter. The setup is schematically represented in Fig. 1. Thus, the longitudinal magnetostriiction effect (Fig. 5) was measured on p-type and n-type germanium. Such measurements may be used to determine such semiconductor parameters as the microscopic drift mobility of carriers and the concentration ratio between carriers of equal sign but different effective mass. The concentration ratio between light and heavy holes in germanium was about 2 per cent. Mention is made of

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Investigation of the Diffusion of Minority Carriers in a Magnetic Field 81947
S/181/60/002/04/05/034
B002/B063

I. K. Kikoin, Noskov, and Pikus. There are 7 figures and 18 references:
7 Soviet, 1 American, 9 British, and 1 French.

ASSOCIATION: Leningradskiy fiziko-tehnicheskiy institut AN SSSR
(Leningrad Physicotechnical Institute of the AS USSR)

SUBMITTED: July 24, 1959

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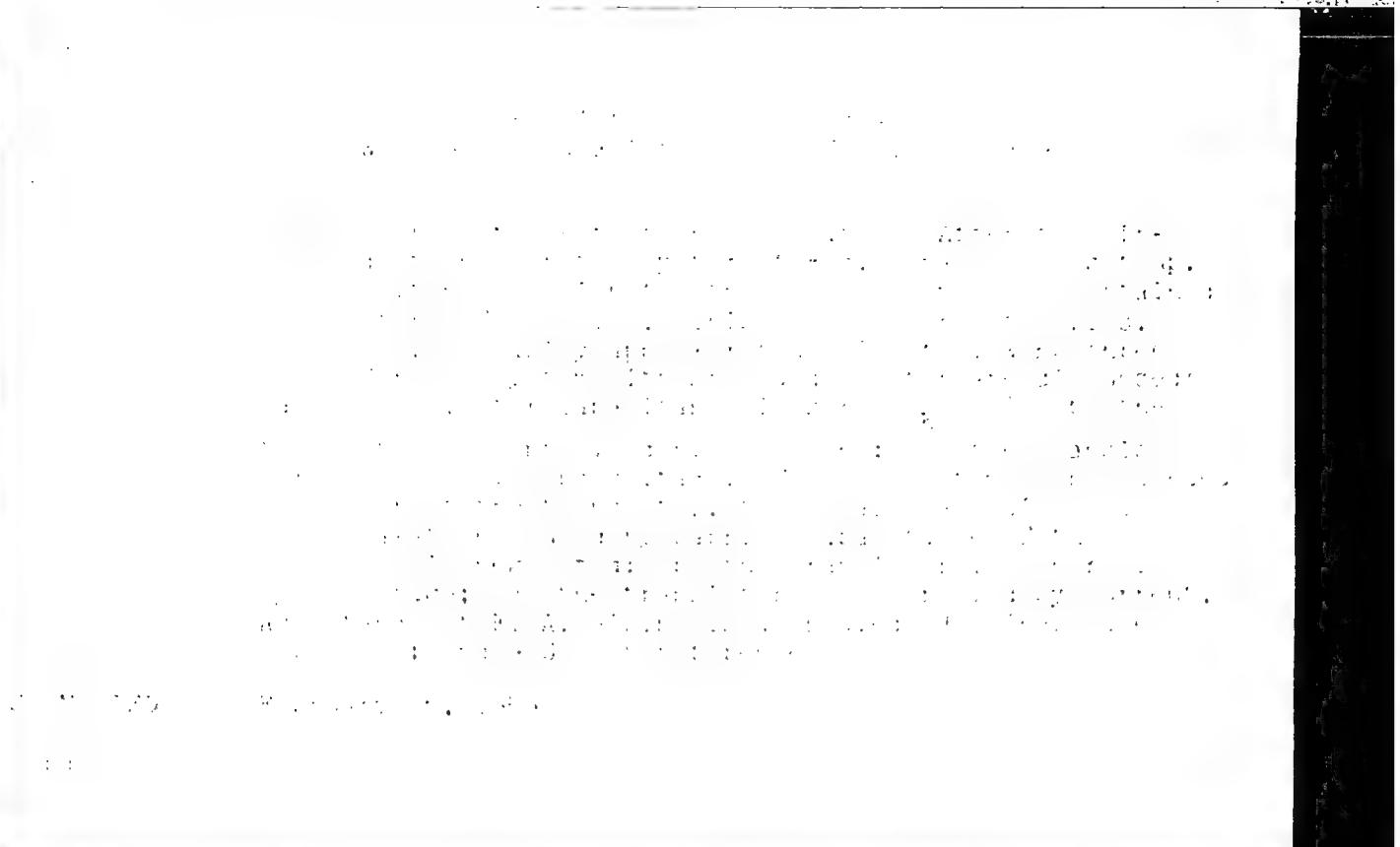
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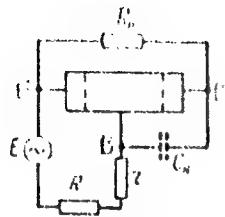


FIG. 1

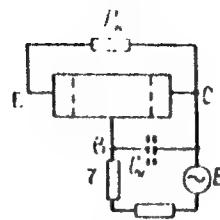


FIG. 2

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94178 (a/c 1137)

010/042
S/181/61/003/001/010/042
B102/B212

AUTHOR: Grinberg, A. A.

TITLE: Theory of the transverse photomagnetic effect

PERIODICAL: Fizika tverdogo tela, v. 3, no. 1, 1961, 94-96

TEXT: In 1956 I. M. Kikoin and Yu. A. Bykovskiy have investigated the transverse photomagnetic effect (ph.m.e.) on germanium very closely; up to that time the anisotropic ph.m.e. on Ge had not been known. The theory of the transverse ph.m.e. has been developed by B. Ya. Mozhes and Yu. N. Obraztsov (1957); they assumed a relaxation time independent of energy, and showed that, if only one type of electrons and holes is present, the transverse ph.m.e. cannot change its sign with increasing H; but this had been proved experimentally for p-type Ge specimens. When considering the existence of heavy and light holes, it is possible to explain the change of sign with p-type Ge theoretically, however, only for such concentration and mobility ratios of heavy and light holes, which are incompatible with data on the Hall constant and others. The only possible experimental explanation is that the change of sign is caused mainly by an anisotropic ph.m.e.; the

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89277

s/181/61/003/001/010/042
B102/B212

Theory of the transverse...

present paper tries to verify this theoretically. The transverse ph.m.e. is calculated with an exact consideration of the carrier scattering mechanism. Using the equations and notations from a previous work (Ref. 8) and taking into account the energy dependence of the relaxation time and the existence of light and heavy holes, one obtains the following expressions for the transverse ph.m.e. of an anisotropic semiconductor:

a) for p-type material ($p_0 \gg n_0$):

$$E^t = \frac{kT}{q} \frac{\Delta n(0) - \Delta n(d)}{d} \frac{\mu_p}{\mu_p \mu_n} \left\{ 1 - \frac{\eta_{ph} \mu_p (1 + i g \theta_p^\infty i g \theta_n^\infty)}{\mu_p^\infty (1 + i g \theta_p^\infty)} \right\} \frac{\sin 2\alpha}{2}; \quad (1)$$

b) for n-type material ($n_0 \gg p_0$):

$$E^t = - \frac{kT}{q} \frac{\Delta p(0) - \Delta p(d)}{d} \frac{\mu_p^\infty}{\mu_p \mu_n} \left\{ 1 - \frac{\mu_p^\infty (1 + i g \theta_p^\infty i g \theta_n^\infty)}{\eta_{ph} \mu_p (1 + i g \theta_p^\infty)} \right\} \frac{\sin 2\alpha}{2}, \quad (2)$$

α denotes the angle which H forms with the exposed semiconductor surface. For weak magnetic fields with scattering of carriers by acoustic vibrations of the lattice, these formulas read as follows:

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S/181/61/003/001/010/042
B102/B212

Theory of the transverse...

a) for p-type material:

$$E^2 = \frac{10}{(D_p + S)} \frac{kT}{qdn_0} \frac{\mu_p}{\mu_p^0} \frac{9\pi}{16} \left(\frac{\mu_p^0}{\mu_p} \right)^2 \left\{ 1 - \left(\frac{\mu_p^0}{\mu_p} \right)^2 \frac{(\lambda+1)^2}{(\lambda+n)^2} \times \right. \\ \left. \times \left[(\lambda+n^2) - \frac{\pi}{4} \frac{(\lambda+n^2)^2}{\lambda+n} \right] + \frac{\pi}{4} \frac{\mu_p}{\mu_p^0} \frac{(\lambda+n^2)(\lambda+1)}{(\lambda+n)^2} \right\} \frac{\sin 2\alpha}{2}; \quad (3)$$

b) for n-type material:

$$E^2 = \frac{10}{(D_p + S)} \frac{kT}{qdn_0} \frac{\mu_p}{\mu_p^0} \frac{9\pi}{16} \left(\frac{\mu_p^0}{\mu_p} \right)^2 \left\{ \left(\frac{\mu_p^0}{\mu_p} \right)^2 \left(1 - \frac{\pi}{4} \right) - \frac{(\lambda+n^2)(\lambda+1)^2}{(\lambda+n)^2} - \right. \\ \left. - \frac{\pi}{4} \frac{\mu_p}{\mu_p^0} \frac{(\lambda+n^2)(\lambda+1)}{(\lambda+n)^2} \right\} \frac{\sin 2\alpha}{2}, \quad (4)$$

and for strong magnetic fields:

a)

$$E_s = \frac{kT}{q} \frac{\Delta n(0) - \Delta n(d)}{d} \frac{\mu_p}{\mu_p^0} \left(1 + \frac{\mu_p^0}{\mu_p} \right) \frac{\sin 2\alpha}{2}, \quad (5)$$

b)

$$E_s = - \frac{kT}{q} \frac{\Delta p(0) - \Delta p(d)}{d} \frac{\mu_p}{\mu_p^0} \left(1 + \frac{\mu_p^0}{\mu_p} \right) \frac{\sin 2\alpha}{2}, \quad (6)$$

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09277

Theory of the transverse...

S/101/61/003/001/010,042
B102/B212

I_0 denotes the illumination intensity, β the quantum yield, λ the concentration ratio of heavy holes to light holes, and κ the mobility ratio. From these formulas it is evident that, even if there are not two types of holes ($\lambda \rightarrow \infty$), the sign of the effect changes in p-type and n-type material alike; the change of sign will take place if the mobility of the majority carriers exceeds the mobility of the minority carriers by several times. For $\lambda = \infty$, the condition for the change in sign of the quadratic effect in isotropic semiconductors is: a) for p-type material: $\mu_p > 4\mu_n(4 - \pi)$; b) for n-type material: $\mu_n > 4\mu_p/(4 - \pi)$. An investigation of the physical nature of the change in sign of the transverse ph.m.e. in an isotropic semiconductor (which has been carried out for a p-type material) shows that this change in sign is related to the focusing effect of the magnetic field upon the ambipolar diffusion current of electron-hole pairs; this effect manifests itself in an additional motion of electrons and holes in the direction of the magnetic field. The sign of the resulting electric field is not only a function of the mobility difference but also caused by the difference of the focusing factors. A change in sign of the transverse ph.m.e. is expected for a material like n-type InSb ($\mu_n > \mu_p$), which is

Card 4/5

89277

S/181/61/003/001/010/042
B102/B212

Theory of the transverse...

only a function of the focusing effect of the magnetic field. The author thanks S. M. Ryvkin, Doctor of Physical and Mathematical Sciences, for discussions. There are 8 references: 7 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR imeni akad. A. F. Ioffe Leningrad (Institute of Physics and Technology AS USSR imeni Academician A. F. Ioffe, Leningrad)

SUBMITTED: May 16, 1960

X

Card 5/5

27298

S/181/003/008/028/034
B109/B202

9.4/78

AUTHORS: Grinberg, A. A., Ryvkin, S. M.

TITLE: Unipolar nonsteady photomagnetic effect

PERIODICAL: Fizika tverdogo tela, v. 3, no. 8, 1961, 2470-2474

TEXT: While under steady conditions the ordinary photomagnetic effect (Kikoin-Noskov) occurs only in the case of bipolar photoconductivity of a semiconductor, a photomagnetic effect (PME) may occur also in a unipolar semiconductor under nonsteady conditions. At the moment of illumination a diffusion current of unbalanced charge carriers is formed because the charges do not have sufficient time to form a counterfield. The noncompensated diffusion current of the unbalanced charge carriers is deflected in the magnetic field thus causing the PME voltage. After the illumination is switched off a voltage of reverse polarity occurs (Fig. 1) due to "suction" of the volume charges. Quantitative estimation: The authors proceed from the formula

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S/181/61/003/008/028/034
B109/B202

Unipolar nonsteady photomagnetic effect

$$\mathbf{J} = \varphi \left\{ \mathbf{j}^0 - \frac{\mu H}{e} (\mathbf{j}^0 \cdot \mathbf{k}) \right\} + (1 - \varphi) (\mathbf{j}^0 \cdot \mathbf{k}) \mathbf{k},$$

rare $\mathbf{j}^0 = e \mu n_0 \mathbf{E} + e D \nabla n; \quad \varphi = \frac{e}{m^* \mu} \left(\frac{\tau_p}{1 + \left(\frac{e \tau_p}{m^* \sigma} H \right)^2} \right); \quad \tau_p = \text{время релаксации}$ (1)

given by A. A. Grinberg (Ref. 1: FTT, II, 836, 1960) (τ_p relaxation time, μ electron mobility, $\tilde{\mu}$ Hall mobility of the electrons, the other denotations are the same as in Ref. 1). Under ordinary conditions, this formula is sufficiently accurate. The following relation is obtained for the electric field

$$E_s = \frac{\mu H}{e} \frac{4 \kappa_e D}{e L} \Delta n_{cM} \cdot \frac{\left\{ \left[\left(\frac{1}{\tau} - \frac{1}{\tau_p} \right) t - 1 \right] e^{-\frac{t}{\tau}} + e^{-\frac{t}{\tau_p}} \right\}}{\left(1 - \frac{t}{\tau_p} \right)^2} \quad (6)$$

where Δn_{cM} is the concentration of the unbalanced carriers in the neutral part of the illumination range of the specimen with $t \rightarrow \infty$, $N_{cM} = N_c \exp(-\Delta E_M/kT)$, where N_c is the effective density of the states of

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Unipolar nonsteady photomagnetic effect

the conduction band, M the total concentration of the defects, and m the concentration of the defects which, in the case of thermal equilibrium, is occupied by electrons, q photon capture cross section in a defect. Fig. 3 shows the relaxation effect of E_x for two ratios $\tau/\tau\sigma$.

$$E_x^{(max)} \approx \frac{\mu H}{e} \frac{4\pi e D}{e L q} \Delta n_{ee} \cdot \frac{\tau_e^2}{\tau}. \quad (9)$$

holds for the maximum value. The short-circuit current is

$$I_{sc} = - \frac{\mu H}{e} e D L_s \frac{e^{-\frac{t}{\tau_e}} - e^{-\frac{t}{\tau}}}{\left(1 - \frac{\tau}{\tau_e}\right)} \Delta n_{ee}, \quad (10), \quad \times$$

the maximum short-circuit current amounts to

$$I_{sc}^{(max)} = e D \frac{\mu H}{e} L_s \Delta n_{ee} \left[\frac{\tau}{\tau_e} \right] \left(\frac{1}{e^{\frac{\tau}{\tau_e}} - 1} \right). \quad (11).$$

The ratio (10) : (11) indicates that the nonsteady unipolar PME is strongly

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Unipolar nonsteady photomagnetic effect

S/181/61/003/008/020/034
B109/B202

marked in poorly conductive materials. Thus, with the following values $L_z = 1\text{cm}$, $L_x = L_y = 0.1\text{ cm}$, $\xi = 16$, $\mu\text{H}/\text{c} \approx 1$, $\Delta n \approx n_0$, $I_{o m o q} \approx 10^{15} 1/\text{sec}\cdot\text{cm}^3$, $4 \cdot 10^{-10}$ a is obtained for the maximum short-circuit current. With a mobility of $\mu \approx 10^3 \text{ cm}^2/\text{v sec}$ the interval resistance $R_i = 10^7 \text{ ohm}$. Thus voltage of 10^{-3} v is formed at a load resistance $R \leq 0.3 R_i$. The authors thank L. E. Gurevich for valuable help. There are 3 figures and 1 Soviet reference.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe AH CCCP, Leningrad (Institute of Physics and Technology imeni A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: March 18, 1961 (initially), April 5, 1961 (after revision)

Card 4/5

9.4160 (also 1137, 1043, 1143)

26.2421

26.2360

89611

S/020/61/136/002/015/034
B019/B056

AUTHORS: Grinberg, A. A., Novikov, S. R., and Ryvkin, S. M.

TITLE: The New Effect of Negative Photoconductivity in a Magnetic Field

PERIODICAL: Doklady Akademii nauk SSSR, 1961, Vol. 136, No. 2, pp. 329-331

TEXT: Fig. 1 shows a scheme of the experimental order, by means of which the authors carried out their experiments. By means of this device they were able to transmit light pulses to the semiconductor in the case of the existence or non-existence of a magnetic field. The photoconductivity without a magnetic field corresponded to the "positive" conductivity, that with magnetic field corresponding to the "negative" conductivity. The effect produced by the photo-emf of the specimen could be inhibited. The explanation of this effect proceeds from the fact that in the motion of the carriers in a magnetic transversal field their trajectory is curved, whereby the resistance is increased. The Hall field formed in this connection partly aligns the trajectories again, and thus decreases the

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89611

The New Effect of Negative Photoconductivity S/020/61/136/002/015/034
in a Magnetic Field B019/B056

growth of the resistance in a magnetic field. Thus, by some decrease of the Hall field, the resistance of the semiconductor is increased. By irradiation with light from the absorption band, electron-hole pairs are produced, and the increase of the electron concentration leads to a decrease of the Hall field. A formula is derived for calculating the negative change in the photoconductivity in n-type germanium, and further, two inequalities are given, by means of which it is possible to determine when no negative photoeffect may be observed in n-type or p-type material. There are 3 figures.

ASSOCIATION: Fiziko-tehnicheskiy institut Akademii nauk SSSR (Institute of Physics and Technology of the Academy of Sciences USSR)

PRESENTED: August 1, 1960, by A. F. Ioffe, Academician

SUBMITTED: July 28, 1960

Card 2/4

The New Effect of Negative Photoconductivity
in a Magnetic Field

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S/020/61/136/002/015/034
B019/B056

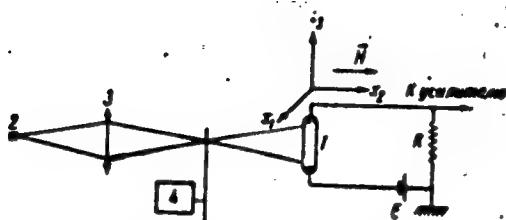


Рис. 1. Схема для изучения отрицательной фотопроводимости в магнитном поле. 1 — образец, 2 — источник света, 3 — объектив, 4 — модулятор света

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89611

The New Effect of Negative Photoconductivity
in a Magnetic Field

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B019/B056

Legend to Fig. 1: 1) Specimen. 2) Source. 3) Objective. 4) Light
modulator.

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24.7700 (1043, 1143, 1482)

33348

S/181/62/004/001/017/052
B108/B104

AUTHOR: Grinberg, A. A.

TITLE: Volt-ampere characteristic of a p-n junction in forward direction

PERIODICAL: Fizika tverdogo tela, v. 4, no. 1, 1962, 99 - 103

TEXT: At present, two principal difficulties spoil the theory of the volt-ampere characteristics of p-n junctions. The first is the infinite increase in carrier concentration, the second is the departure of the experimental voltampere characteristic from the "root-I" law. These difficulties are explained by a space charge in the p-n junction. In the calculations it is assumed that the p- and n-domains are perfectly symmetric in geometry as well as in their properties. Recombination in the junction is neglected. The strong currents in the forward direction only are considered so that the voltage drop across the narrow band of space charge can be neglected. The volt-ampere characteristic in this case is calculated as

$$V = - \frac{kT}{e} \{2I - L\}L, \text{ where } L = 1K, K = \sqrt{4\pi e^2 N_d / \epsilon kT}, I = J/J_0, J_0 = eDN_j K,$$

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33348

Volt-ampere characteristic of ...

S/81/62/004/001/017/052
B108/B104

N_d = concentration of donor impurities. It is shown that with rising current, carrier concentration increases up to a maximum and then decreases again. This behavior is due to the increasing effect of the electric field with increasing current so that carrier diffusion is gradually reduced and a space charge occurs. If the electric field strength increases more rapidly than current, the injected carrier concentration will decrease. The author thanks S. M. Ryvkin, Doctor of Physics and Mathematics, and A. A. Rogachev for discussions. There are 2 figures and 5 references: 3 Soviet and 2 non-Soviet. The 2 references to the English-language publications read as follows: N. H. Fletcher. Proc. IRE, 45, 862, 1957; A. K. Jonscher. J. Electr. and Control., 5, 1, 1958.

ASSOCIATION: Fiziko-tehnicheskiy institut im A F Ioffe AN SSSR
Leningrad (Physicotechnical Institute imeni A. F. Ioffe AS
USSR, Leningrad)

SUBMITTED: July 12, 1961

Card 2/2

GRINEBERG, A.A.; NIKULAYEV, I.N.

On the photomagnetic effect on a p-n junction. Dokl. AN SSSR
147 no. 5:1057-1060 D '62.

(MIRA 16:2)

1. Moskovskiy gosudarstvennyy universitet im. M.V. Lomonosova i
Fiziko-tehnicheskiy institut im. A.F. Ioffe AN SSSR. Predstavлено
akademikom I.K. Kikoinym.
(Photomagnetic effect) (Junction transistors)

GRINEERG, A.A.

Coherent emission of long-wave phonons by nonequilibrium current
carriers in semiconductors. Fiz. tver. tela 6 no.2:590-592 F '64.

1. Fiziko-tehnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.
(MIRA 17:2)

ACCESSION NR: APL019859

S/0181/64/006/003/0911/0914

AUTHOR: Grinberg, A. A.

TITLE: Amplification of ultrasound in semimetals and semiconductors with internal conductance

SOURCE: Fizika tverdogo tela, v. 6, no. 3, 1964, 911-914

TOPIC TAGS: ultrasonic absorption, semimetal, charge carrier, ponderomotive force, acoustic wave propagation, hole drift

ABSTRACT: The coefficient of ultrasonic absorption α (amplification) has been calculated in semimetals under strong transverse electric and magnetic fields. The calculation includes recombination of nonequilibrium charge carriers, the deformation potential of ponderomotive (Lorentz) force, and increase in lattice charges. These are included in the equation for acoustic wave propagation along the axis Oy, axis of electron and hole drift for $\lambda_{ph} \ll \lambda_{ac}$ (λ_{ph} - mean free path of thermal phonons, λ_{ac} - wave length of acoustic wave), and an expression for α is derived from the resulting dispersion equation. Under the conditions

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ACCESSION NR: AP4019859

of coefficient amplification $E_c/H_s < -1$, the "viscous" action effect of electron-hole gas is shown to lead to the inequality

$$\beta \ll \left| \frac{E_c}{H_s} \right| \frac{\omega^2}{m_p \cdot k^2 (E_n - E_p)^2}$$

For InSb at 77K, $H \sim 3 \times 10^4$ oersted, $|E_n - E_p| \sim 15$, and $|E_c/H_s| = 2$ this inequality yields $\omega < 10^7 \text{ sec}^{-1}$. The author is grateful to L. E. Gurevich, V. L. Gurevich and V. G. Skobov for their help and advice. Orig. art. has: 12 formulas.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe AN SSSR Leningrad
(Physicotechnical Institute AN SSSR)

SUBMITTED: 17Jun63

DATE ACQ: 31Mar64

ENCL: 00

SUB CODE: PH

NO REF Sov: 005

OTHER: 002

Card 2/2

ACCESSION NR: APL028457

S/0181/64/006/004/1228/1229

AUTHOR: Grinberg, A. A.

TITLE: A possible experimental verification of the relation between the absorption coefficient of ultrasonic energy and the acoustical-electron current in solids

SOURCE: Fizika tverdogo tela, v. 6, no. 4, 1961, 1228-1229

TOPIC TAGS: ultrasonics, acoustical electron current, absorption coefficient

ABSTRACT: When sound is completely absorbed in a sample, the acoustical-electron emf should not depend on the absorption coefficient but should be determined entirely by the absorption of sound energy falling on unit area of a sample per unit time. The author used the relations derived by G. Weinreich (Phys. Rev., 107, 317, 1957) to find the desired relations, and he obtained the following expression: $j = -\frac{\mu_n W_0}{2ds} (1 - e^{-2sd}) f(\omega)$, where j is the current density, μ_n the electron mobility, W_0 the sound energy absorbed by unit area per unit time, $f(\omega)$ a correction factor that is equal to unity when Weinreich's relations are satisfied, \propto the absorption coefficient of ultrasonic energy, d the length of the sample, and s the velocity of sound. This equation may be used to determine Weinreich's

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ACCESSION NR: AP4023457

relations when $2\alpha d \gg 1$. Its advantage over measurement of the acoustical-electron emf lies in the fact that a larger absorption coefficient is achieved with larger concentrations of current carriers, which leads to a small acoustical-electron emf. At the same time, the acousto-electrical current does not depend on carrier concentrations at $2\alpha d \gg 1$. This may appear paradoxical, but it must be borne in mind that the condition $2\alpha d \gg 1$ cannot be obtained in the absence of free current carriers. Orig. art. has: 5 formulas.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad
(Physicotechnical Institute AN SSSR)

SUBMITTED: 22Oct63

DATE ACQ: 27Apr64

ENCL: 00

SUB CODE: SS, OP

NO REF Sov: 000

OTHER: 007

Card 2/2

L 7042-65 EWT(1)/EWG(k)/EWT(g)/T/EWP(q)/EWP(b) Ez-6 IJP(c)/AFWL/ESD(a),
3SD/RAEM(a)/ESD(ga)/ECD(t)/REAM(t) JD/AT
ACCESSION NR# AP4041700

8/0181/64/006/007/2010/2013

AUTHOR: Grinberg, A. A.

TITLE: Acoustic magnetoelectric effect in semiconductors)

SOURCE: Fizika tverdogo tela, v. 6, no. 7, 1964, 2010-2013

TOPIC TAGS: acoustic magnetoelectric effect, ultrasonics, semiconductor, semiconductor ultrasound absorption, indium antimonide

ABSTRACT: A new effect in intrinsic semiconductors has been described, involving the interaction of acoustic, magnetic, and electric fields. Longitudinal ultrasonic oscillations directed at right angles to a magnetic field will generate a potential difference along the third orthogonal axis. The effect is explained by the generation of equal flows of electrons and holes excited by the absorption of sound and deflected in opposite directions by the magnetic field. The intensity of the effect, which is related to the degree of absorption of ultrasound, can also be amplified to a considerable degree by illuminating the specimen with light. For an indium antimonide specimen 1 cm long, the resulting potential difference will be 10^{-4} v, given

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B

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ACCESSION NR: AP4041700

the ultrasonic field parameters of 1 watt and $\omega = 10^9 \text{ sec}^{-1}$, and a temperature of 300 K. "The author thanks S. M. Ryvkin for discussing the results of this work." Orig. art. has: 17 formulas and 1 figure.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe AN SSSR
Leningrad (Physicotechnical Institute, AN SSSR)

SUBMITTED: 03Dec63 ATD PRESS: 3104 ENCL: 00
SUB CODE: SS, GP NO REF Sov: 004 OTHER: 001

2/2

ACCESSION NR: AP4034031

S/0020/64/155/006/1293/1293

AUTHOR: Grinberg, A. A.

TITLE: Elucidation of Saturation of the drift velocity of current carriers in piezoelectric semiconductors

SOURCE: AN SSSR. Doklady*, v. 155, no. 6, 1964, 1293

TOPIC TAGS: semiconductor drift velocity, piezoelectric semiconductor, volt ampere characteristic, acoustical electric current, semiconductor sound velocity, CdS, CdSe, GaAs, semiconductor, solid state circuitry

ABSTRACT: It has been found by R. W. Smith (Phys. Rev. Letters 9, 87, 1962) that the drift velocity v of the charge carriers (and therefore the current density) levels off with an increase of voltage in piezoelectric semiconductors (CdS, CdSe, GaAs) when it becomes equal to, or greater than, the sound velocity s . Furthermore, this deviation from Ohm's law is accompanied by a large flux of ultrasonic energy. This phenomenon is interpreted by using the concept of acoustico-electric current which is a part of the total current. If $v = s$, the

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SEARCHED AND INDEXED AP-034031

former is opposite to the latter. The present author expresses this idea quantitatively. The excess of power is spent in that case not on generation of ultrasonic oscillations, but on heat evolution. The quantitative consideration of the increase of the heat noises and of the fact that the potential difference at the specimen is given not only by the Ohmic part of the electric field, but also by the acoustico-electric emf, leads to a volt·ampere characteristics which agrees with the experimental findings. Orig. art. has: no figures, 1 eq.

ASSOCIATION: Fiziko-tekhnicheskiy institut im A. F. Ioffe Akademii nauk SSSR
(Physics-Engineering Institute, Academy of Sciences SSSR)

SUBMITTED: 18Nov63

DATE ACQ: 20May64

ENCL: 00

SUB CODE: GP

NO REF Sov: 000

OTHER: 002

Card 2/2

ACCESSION NR: AP4042018

S/0020/64/157/001/0079/0082

AUTHORS: Grinberg, A. A.; Kramer, N. I.

TITLE: Acousto-magnetic effect in piezoelectric semiconductors

SOURCE: AN SSSR. Doklady*, v. 157, no. 1, 1964, 79-82

TOPIC TAGS: piezoelectric effect, semiconductor, indium antimonide, semiconductor conductivity, carrier density, ultrasonic wave propagation

ABSTRACT: The effect described is present only in piezoelectric semiconductors with bipolar conductivity, the properties of which have not yet been treated in the literature. It consists in the fact that if ultrasound is transmitted through a piezoelectric placed in a magnetic field in a direction perpendicular to the magnetic field, then an electric field is produced in the third direction. The reason for the current is the deflection of the electrons and

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ACCESSION NR: AP4042018

holes which are dragged by the ultrasonic waves in opposite directions, which produces a potential difference. The electromagnetic equations are solved in the case of a one-dimensional model of a piezoelectric with equal electron and hole densities. Formulas are derived for the coefficient of absorption (amplification) of the ultrasound, for the current density, and for the acousto-magnetic field. The results show that in case of piezoelectric interaction the absorption coefficient at fixed frequency decreases with the increasing carrier density, whereas the absorption coefficient due to the deformation potential (which is present in all semiconductors) increases. In InSb, the acousto-magnetic effect in the region of presently available ultrasound frequencies is determined completely by the deformation potential, and not by the piezomechanical property. Orig. art. has: 3 figures and 11 formulas.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe Akademii nauk SSSR (Physicotechnical Institute, Academy of Sciences, SSSR)

Card 2/4

ACCESSION NR: AP4042018

SUBMITTED: 31Jan64

ENCL: 01

SUB CODE: SS

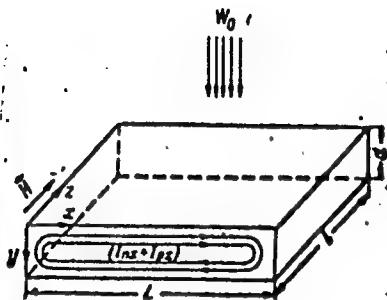
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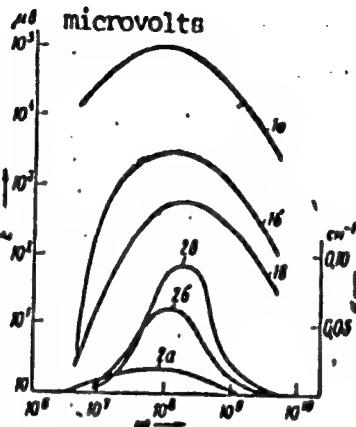
Card 3/4

ACCESSION NR: AP4042018

ENCLOSURE: 01



Relative directions of fields and current



Dependence of acousto-magnetic voltage (curves 1) and of coefficient of ultrasound absorption (curves 2) on the frequency for three values of the concentration.

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L 14292-65 EVA(h)/EWG(k)/EWP(k)/EWT(1)/T Pf-4/Pi-4/Pz-6/Peb IJP(c) AT
ACCESSION NR: AP4049127 S/0020/64/159/001/0049/0052

AUTHOR: Konstantinov, B. P.; Grinberg, A. A.; Kastal'skiy, A. A.; Ry*vkin, S. M.

TITLE: Generation of ultrasound in the p-n junction of a nonpiezo-electric material

SOURCE: AN SSSR. Doklady*, v. 159, no. 1, 1964, 49-52, and bottom half of insert facing p.44

TOPIC TAGS: ultrasound, ultrasound generation, semiconductor ultrasonics, p-n junction ultrasonics

ABSTRACT: Proceeding from the work of D. L. White (IRE, TVE-9, 1962) on the generation of ultrasound in a GaAs-to-metal transition layer, the authors investigated analytically and experimentally the possibilities of ultrasound generation in a usual p-n junction or in any barrier layer of nonpiezoelectric materials. The generating mechanism in this case is the attraction between the donors and the acceptors of the space charge zone. An outside potential applied to the junction

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ACCESSION NR: AP4049127

will effect a change in the thickness of the space charge and thus change the force of attraction, which in turn determines the stress within the crystal. Resonance conditions are investigated in the case of a high bias potential applied in the barrier direction and a low sinusoidal exciting voltage, the diode being acoustically loaded from the side of the n-region by a continuous medium of the same material as the junction, while its p-region is bounded by vacuum. Expressions for the amplitude and the acoustical energy at resonance are derived and applied to real conditions where the regions of a p-n junction adjacent to the space charge are finite and the energy is radiated into a medium with an acoustic resistance differing from that of the junction material. Three limiting cases are then considered: the case of a symmetric system with equal p and n regions, p and n regions larger than the thickness of the acceptor space charge; the case of the acceptor space charge being much thinner than that of the donors and both being much thinner than the p and n regions; and a similar case modified by the p region being much thinner than the n region of the junction. The second is considered

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ACCESSION NR: AP4049127

to be the most favorable theoretically as well as experimentally. Calculations show that in a Ge junction in air, with the donor concentration of 10^{17} per cm^3 being much lower than that of the acceptors, at a sinusoidal voltage of 3 v, a bias of 30 v, the p and n regions having a total thickness of 0.5 cm, the pressures developing in the specimen reach the order of 3 kg/cm^2 , and the radiated power is about $0.4 \times 10^{-5} (2n + 1)^2 \text{ W/cm}^2$ ($n = 1, 2, \dots$). In an experimental test, the amplitude of the oscillations proved to be proportional to the sinusoidal voltage, and the relative lattice displacement in the direction perpendicular to the p and n contact plane reached a value of the order of 10^{-3} at a sinusoidal voltage of 3 v and a bias of 15 v. Due to internal losses, however, the experimental width of the resonance region greatly exceeded the theoretical value, which caused the amplitude to drop by about 3 orders of magnitude below the theoretical. Orig. art. has: 1 figure.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe, Akademii nauk, SSSR (Physicotechnical Institute, Academy of Sciences SSSR)

Card 3/4

L 14292-65
ACCESSION NR: AP4049127

SUBMITTED: 03Aug64 ENCL: 00 SUB CODE: SS
NO REF SOV: 000 OTHER: 001 ATD PRESS: 3136

L 63512-65 ENT(1)/T/EWA(h) Pz-6/Peb IJP(c) AT
ACCESSION NR: AP5017319 UR/0181/65/007/007/2195/2205

AUTHOR: Ryvkin, S. M.; Grinberg, A. A.; Kramer, N. I.

26
25
B

TITLE: Indirect optical transitions in semiconductors accompanied by interaction with charge carriers

21

SOURCE: *Fizika tverdogo tela*, v. 7, no. 7, 1965, 2195-2205

TOPIC TAGS: semiconductor, indirect transition, free carrier, optical transition, semiconductor laser.

ABSTRACT: A new indirect transition mechanism in semiconductors involving free carriers rather than phonons is analyzed. It is shown that absorption and emission of photons with energies less than the width of the forbidden gap accompanied by transfer of energy and momentum between electrons (holes) and free carriers is possible. A cross section is calculated for capture of photons as a result of such transitions averaged over the energies of electrons (holes). It is pointed out that absorption of photons by means of such a process can be achieved by applying an electric field to a sample which has been cooled to a low temperature in order to generate the hot electrons required for such a transition. The possibility of an

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L 63512-65

ACCESSION NR: AP5017319

indirect free-carrier-assisted transition laser is discussed in another paper (A.A. Grinberg, et al. FIT, v. 7, no. 7, 1965, 2206). Orig. art. has: 20 formulas, 5 figures, and 1 table.

(CS)

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. P. Ioffe AN SSSR, Leningrad
(Physicotechnical Institute, AN SSSR)

SUBMITTED: 23Feb65

ENCL: 00

SUB CODE: SS, EC

NO REF Sov: 002

OTHER: 007

ATD PRESS: 4049

b6
Card 2/2

L 63511-65 EVA(k)/FBD/ENG(r)/EWT(1)/EEC(k)-2/T/EEC(b)-2/EWP(k)/EVA(h)/
EVA(m)-2 Pm-4/Pn-4/Po-4/Pf-4/Pi-4/Pl-4/Peb SCTB/IJP(c) WG
ACCESSION NR: AP5017320 UR/0181/65/007/007/2206/2208

63
C2
B

AUTHOR: Grinberg, A. A.; Rogachev, A. A.; Ryvkin, S. M.

TITLE: Possibility of negative absorption at free-carrier-assisted indirect transitions

SOURCE: Fizika tverdogo tela, v. 7, no. 7, 1965, 2206-2208

TOPIC TAGS: ²⁵laser, semiconductor laser, indirect transition, indirect transition laser, stimulated emission, negative absorption

ABSTRACT: An analysis is conducted of criteria required to attain negative absorption due to indirect transitions involving transfer of energy and momentum between electrons (holes) and free carriers. Such a mechanism, first discussed by S. M. Ryvkin in FTT, v. 7, no. 4, 1965, p. 1278, and later analyzed by Ryvkin et al. in FTT, v. 7, no. 7, 1965, p. 2195, requires the presence of an applied electric field to generate hot carriers. Since the main advantage of any indirect transition laser is that only a small concentration of charge carriers is required, the authors consider only the nondegenerate case (absence of carrier degeneracy). It is shown that the criteria for attaining negative absorption by means of indirect free-carrier-assisted transitions is identical to those for phonon-assisted transitions, derived by N. G. Basov et al. in 1960. It is shown that amplification can be achieved at a

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ACCESSION NR: AP5017320

moderate concentration of excess carriers in semiconductors with the valence and the conduction band minima not displaced relative to one another in the energy momentum space and for photons with energies several hundreds of ev smaller than the width of the forbidden gap. In the calculations the free carrier absorption, believed to be mainly responsible for failure to achieve laser action by means of indirect phonon assisted transitions (W. Dumke, Physical Review, v. 127, 1962, p. 1559), was taken into account. Orig. art. has: 4 formulas and 1 figure. [CS]

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad
(Physicotechnical Institute, AN SSSR)

SUBMITTED: 23Feb65

ENCL: 00

SUB CODE: SS,SC

NO REF SOV: 003

OTHER: 002

ATD PRESS: 4049

Oct
Card 2/2

L 30049-65 EWT(1)/EWT(m)/T/EWP(t)/EWP(k)/EWP(b) Pf-4/P1-4 IJP(c) JD

ACCESSION NR: AF5005245

S/0057/65/035/002/0376/0380

AUTHOR: Grinberg, A.A.; Kastal'skiy, A.A.; Ryvkin, S.M.

TITLE: Excitation of ultrasonic vibrations in germanium by current pulses 27

SOURCE: Zhurnal tekhnicheskoy fiziki, v.35, no.2, 1965, 376-380 B

TOPIC TAGS: germanium, ultrasonic vibration, thermal shock, current pulse

ABSTRACT: Rectangular parallelepipeds of n-type germanium were excited by short current pulses and their subsequent mechanical vibration was observed with a piezoelectric transducer fixed to one end. The samples were $4 \times 4 \times h$ mm³ in size, where h varied from 6 to 20, and the resistivity of the material was 0.3 ohm cm. Square current pulses with a 0.5 microsec rise time, various durations of the order of 10 microsec, and intensities up to 1000 A/cm³ were introduced at the square faces. Mechanical vibrations with an amplitude proportional to the square of the current density and a frequency equal to the mechanical resonant frequency of the specimen (approximately 125 Kc/sec for the 20 mm long specimen) were thereby excited. The excitation of the vibrations is ascribed to thermal shock due to the Joule heat evolved. Two independent trains of vibrations were excited by each pulse: one by

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L 30049-65
ACCESSION NR: AP3005245

the current rise at the beginning of the pulse, and another, with opposite phase, by the current drop at the end. This is evinced by the fact that the vibrations were particularly strong when the pulse duration was equal to a half-period of the mechanical vibration and were nearly absent when the pulse duration was a full period. A theory of the thermal excitation of mechanical vibrations is developed, and the predictions of the theory are shown to be in reasonable agreement with the experimental data. Orig.art.has: 16 formulas and 3 figures.

[02]

ASSOCIATION: none

SUBMITTED: 18May64

ENCL: 00

SUB CODE: SS,GP

NR REF Sov: 002

OTHER: 000

ATD PRESS: 3194

L 27730-66 EWT(1)/T IJP(c)

ACC NR: AP6015480

SOURCE CODE: UR/0181/66/008/005/1555/1561

41

B

AUTHOR: Grinberg, A. A.; Kramer, N. I.

ORG: Physicotechnical Institute im. A. F. Ioffe AN SSSR, Leningrad (Fiziko-tehnicheskiy institut AN SSSR)

TITLE: Light-light scattering in semiconductors and insulators

SOURCE: Fizika tverdogo tela, v. 8, no. 5, 1966, 1555-1561

TOPIC TAGS: neodymium, light scattering, laser optics, phonon scattering, semiconductor laser

ABSTRACT: The authors consider photon-photon scattering in insulating crystals. The process is caused by the polarizability of the crystal due to virtual transitions of electrons from the valence band to the conduction band. The dipole approximation is used for calculating the scattering cross section. It is shown that the scattering of phonons with energy $\hbar\omega$ much less than the width of the forbidden band is proportional to ω^6 . When $\hbar\omega_1 + \hbar\omega_2 \ll E_g$, the cross section is of the order of 10^{-28} cm^2 . The practical feasibility of using a neodymium laser for observing photon-photon scattering is evaluated. The number of quanta scattered at the interaction of two light beams with volume V in a time t where the intensities of the beams (in $\text{kW/cm}^2 \cdot \text{sec}$)

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L 27730-66

ACC NR: AP6015480

are I_1 and I_2 is equal to

$$\Delta N = \frac{I_1 I_2 n}{c_0} \sigma V t$$

where n is the refractive index. A neodymium laser with a power of 10^6 w gives $I_1 = I_2 = 10^{24}$ kw/cm² sec for a time $t \sim 10^{-3}$ sec for a focusing area of 10 cm². For the given scattering cross section, $n=3$, $V=30$ cm³ and $\Delta N=3 \cdot 10^8$. Orig. art. has: 2 figures, 11 formulas.

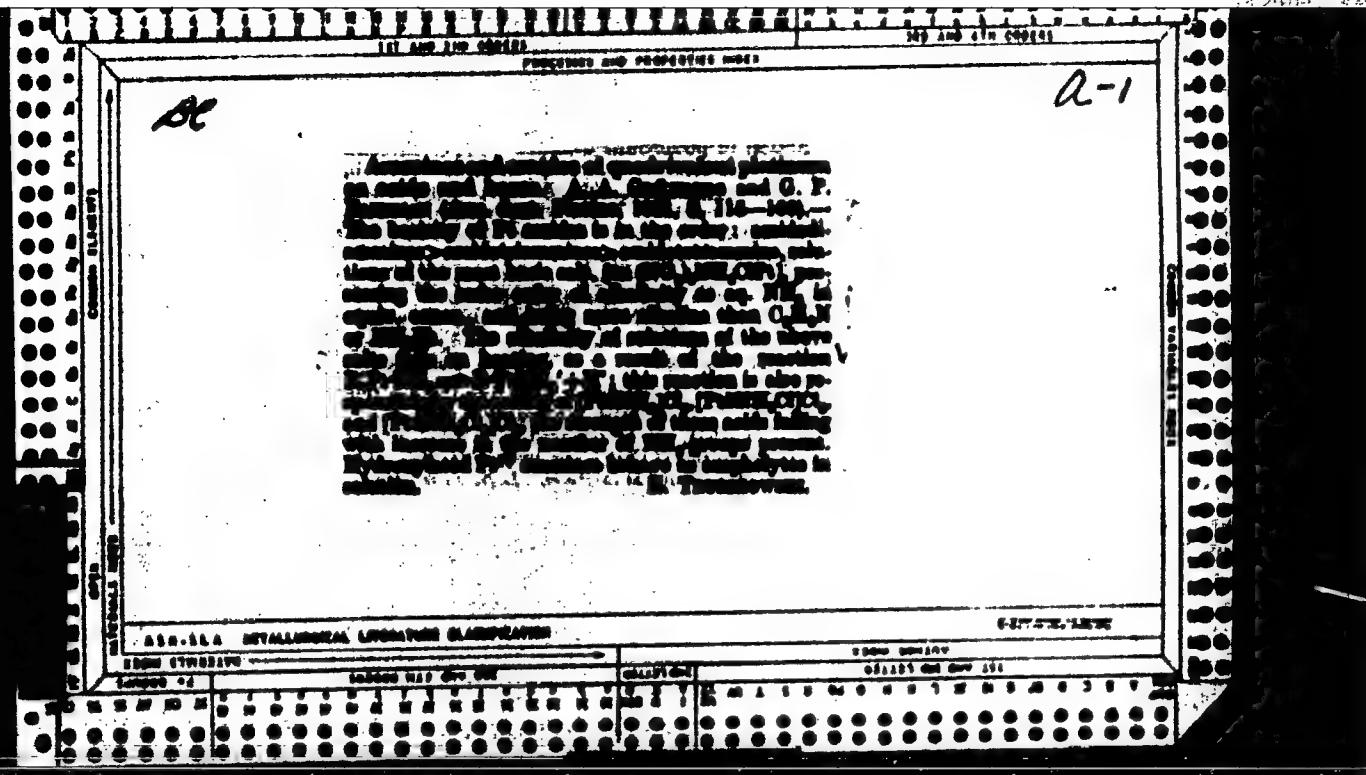
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[14]

SUB CODE: 20/ SUBM DATE: 01Jul65/ ORIG REF: 002/ OTH REF: 013/
ATD PRESS: 5002

Card 2/2 BLG

"APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051683



APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051683(

GRINBERG, A.A.

PROPERTIES AND REACTIONS

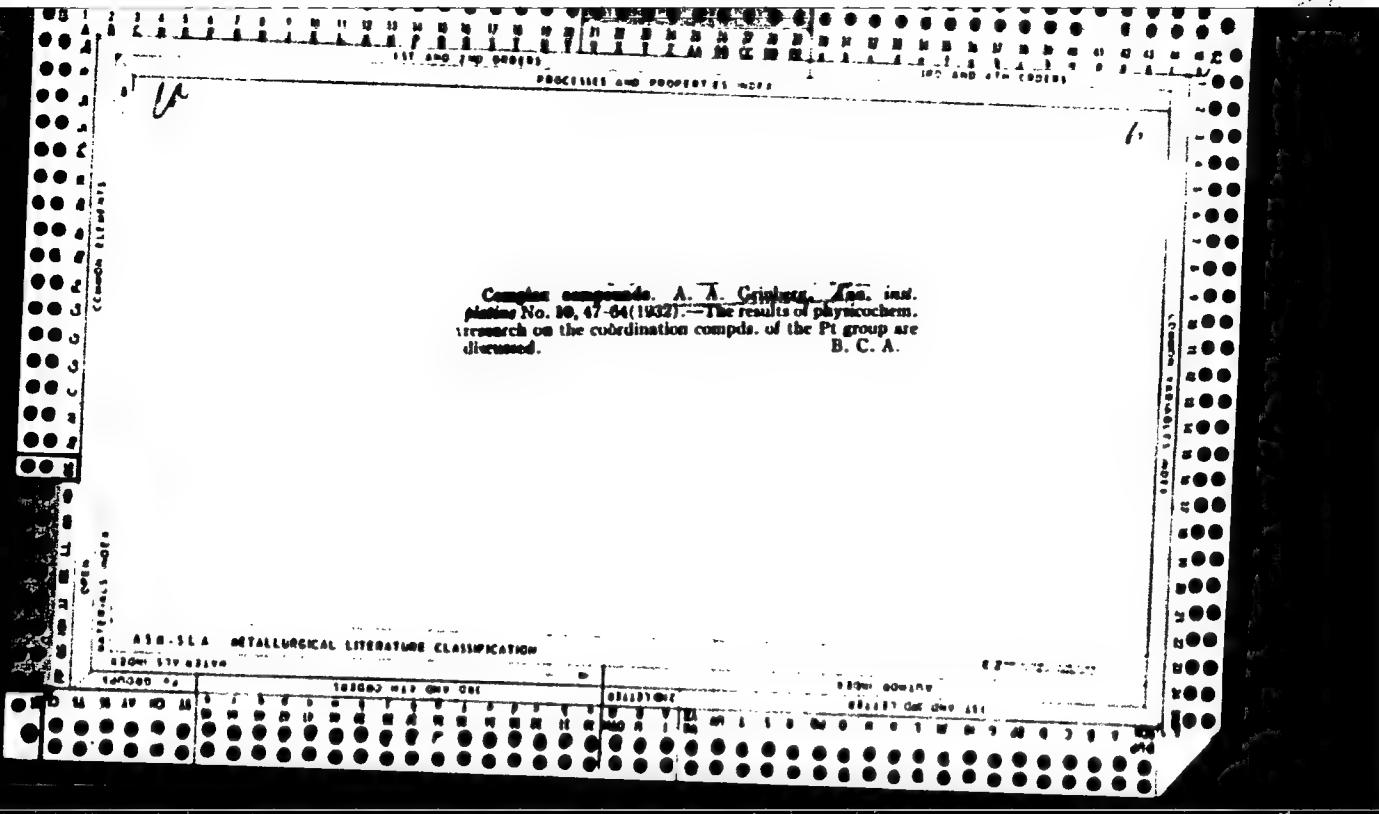
NP

Thermal decomposition of bisulfot platinum ammonia. A.A. Grinberg and
B.V. Pritsker. Ann. Inst. phys. No. 9, 73-80 (1902) — The thermal stability of compds.

having the general formula $[Pt(NH_3)_4]X_2$ decreases in the following order: $SO_4 > CrO_4 > Cl_4 > NO_3 > I_4 > (SCN)_2$. The transition temps are 225°, 218°, 178°, 166°, 138° and 117°, resp. In the thermal decompn. of $[Pt(NH_3)_4]Cl_2$, $[Pt(NH_3)_4]Br_2$, $[Pt(NH_3)_4](NO_3)_2$ and $[Pt(NH_3)_4](SCN)_2$ in air, there are formed intermediate products with evolution of NH_3 according to $[Pt(NH_3)_4]X_2 \rightarrow [Pt(NH_3)_3]X_2 + 2NH_3$. The thermal decompn. of thiocyanate under similar conditions takes place in part in the manner and in part according to $2[Pt(NH_3)_4](SCN)_2 \rightarrow [Pt(NH_3)_3]_2 + [Pt(SCN)_4] + 4NH_3$. In the thermal decompn. of dry tetrammine thiocyanate $[Pt(NH_3)_4](SCN)_2$ is formed exclusively. The vapor pressures detd. are for $[Pt(NH_3)_4]Cl_2$ 63 mm. at 100°, and 110 mm. at 207°; $[Pt(NH_3)_4]Br_2$, 64 mm. at 170°, and 118 mm. at 180°; $[Pt(NH_3)_4]I_2$ 89 mm. at 180°, and 264 mm. at 178°. The transition temp. for dry $[Pt(NH_3)_4]Cl_2$ is 170-2°. The stabilities of various compds. of the type $[Pt(NH_3)_4]X_2$ are of approx. the same order as those of the tetrarnines.

W. P. Karras

ALO-SEA METALLURGICAL LITERATURE CLASSIFICATION

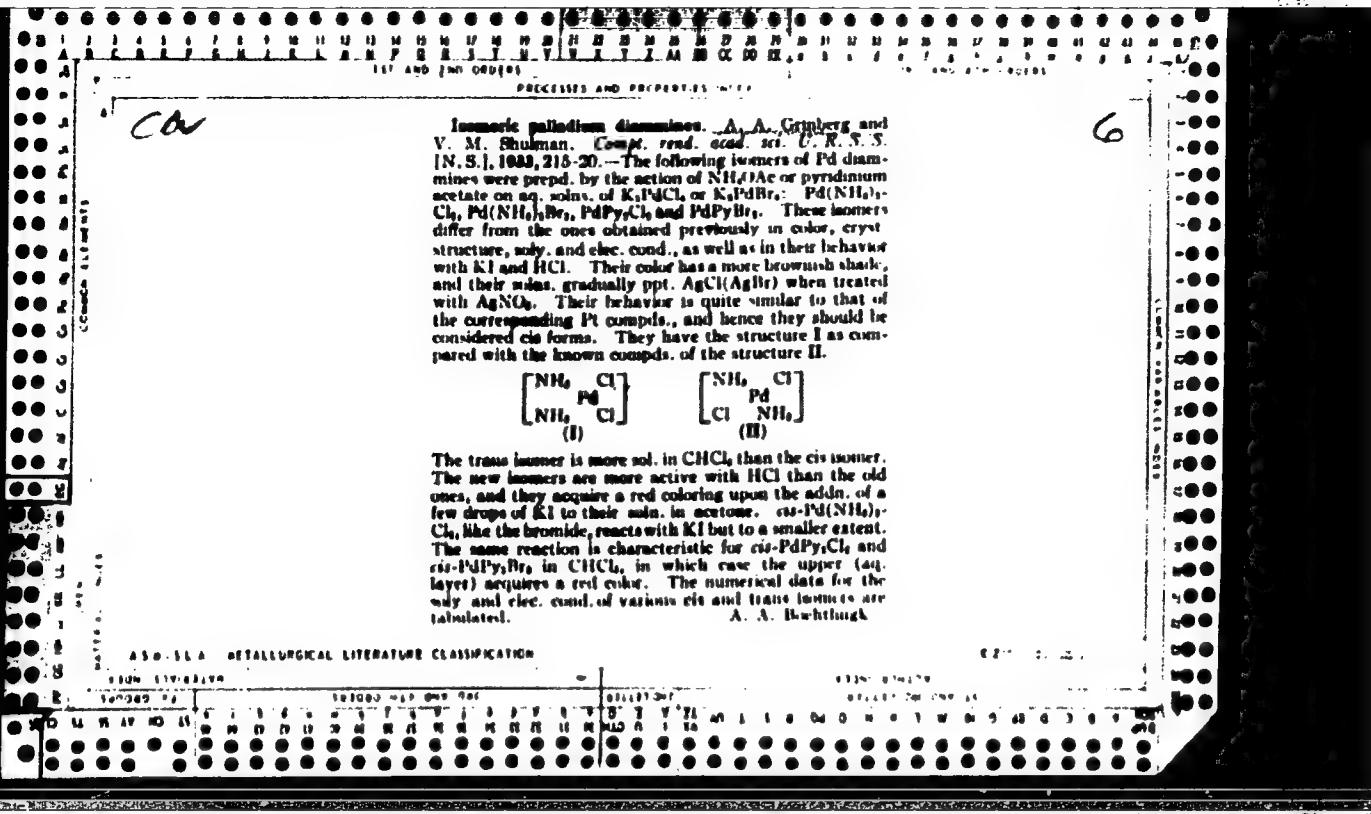


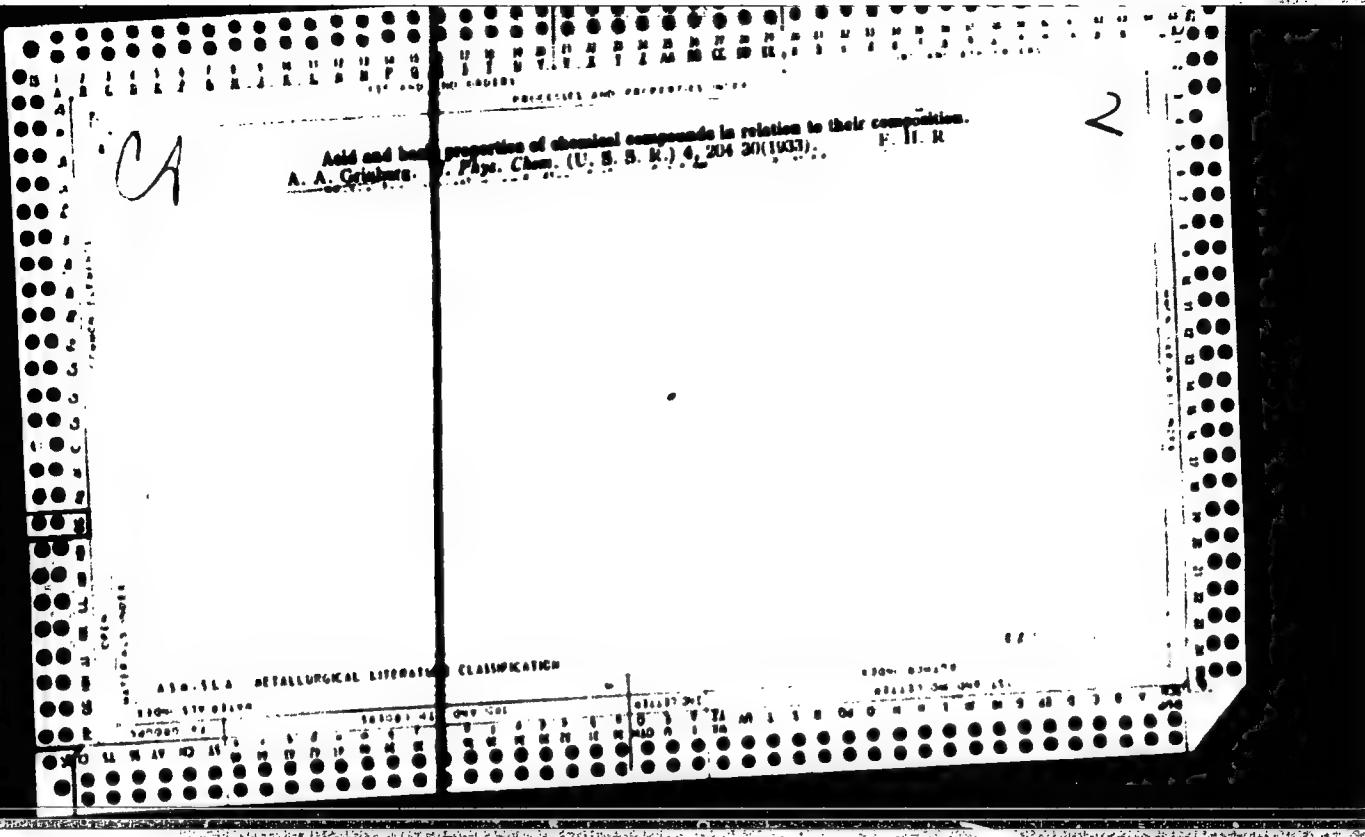
la

g

The occurrence of gallium in the sulfide ores of Ridder.
Abstr. A. A. Grinberg, A. N. Filippov and I. I. Yavkov
skii. *Compt. rend. acad. sci. U. R. S. S.* 1933, 60-71.
The richest source of Ga was the Zn concentrate obtained
by flotation. It contained 5.8 mg. Ga per kg., chiefly in
association with sphalerite. S. Bradford Stone

CLASSIFICATION BY SOURCE OF LITERATURE CLASSIFICATION





***Volumetric Methods of Determining Metals of the Platinum Group.** A. A. Grinberg and B. V. Ptitsin (*Doklady Akademii Nauk S.S.R.* (USSR), *1968*, [S.R.], 10), 284-290.—[In Russian and French.] Potentiometric titration of Ir^{IV} salts with KMnO_4 can be applied not only in pure Ir^{IV} solutions, but also in the presence of Rh^{III} , Ir^{IV} , Pt^{IV} , Pd^{IV} , and Ru^{IV} salts. Potentiometric titration of Ir^{IV} salts with $(\text{NH}_4)_2\text{Fe(SO}_4)_2$ is useful in the presence of Ir^{IV} , Pt^{IV} , Rh^{III} , and Pd^{IV} . Pt^{IV} may be determined by reduction to Pt^{IV} with solution of Cu_2O_4 in HCl, followed by differential potentiometric titration with KMnO_4 in a current of CO_2 in the presence of excess of MnSO_4 . Pt^{IV} and Ir^{IV} may be determined simultaneously by potentiometric titration with KMnO_4 ; the presence of Ir^{IV} in the solution has no influence on the result.—N. A.

CA

2

The dissolving effect on a substance of a mixture of solvents that do not dissolve it separately. A. A. Grinberg and V. M. Shulman. *Acta. Inst. Petrol.* No. 11, 111-23 (1953). -- [Pt(NH₃)₄][Pt(SCN)₄] dissolves in mixts of Me₂CO and H₂O, MeOH and H₂O, and MeCOEt and H₂O, although it is insol. in each separately in the cold. It is slightly sol. in boiling H₂O. The max. solv. in Me₂CO-H₂O lies at 61.7% by wt. of Me₂CO, and for MeOH-H₂O at a point corresponding approx. to 4MeOH-3H₂O. [Pt₂][Pt(SCN)₄], [Pd(NH₃)₄][Pd(SCN)₄] and to a lesser extent [Ni₂(en)₃][Pt(SCN)₄] show the same effect. Probably different parts of the mol. are solvated by the different solvents, so that a mixt. of the solvents is sufficient to dissolve the salt. H. M. Leicester

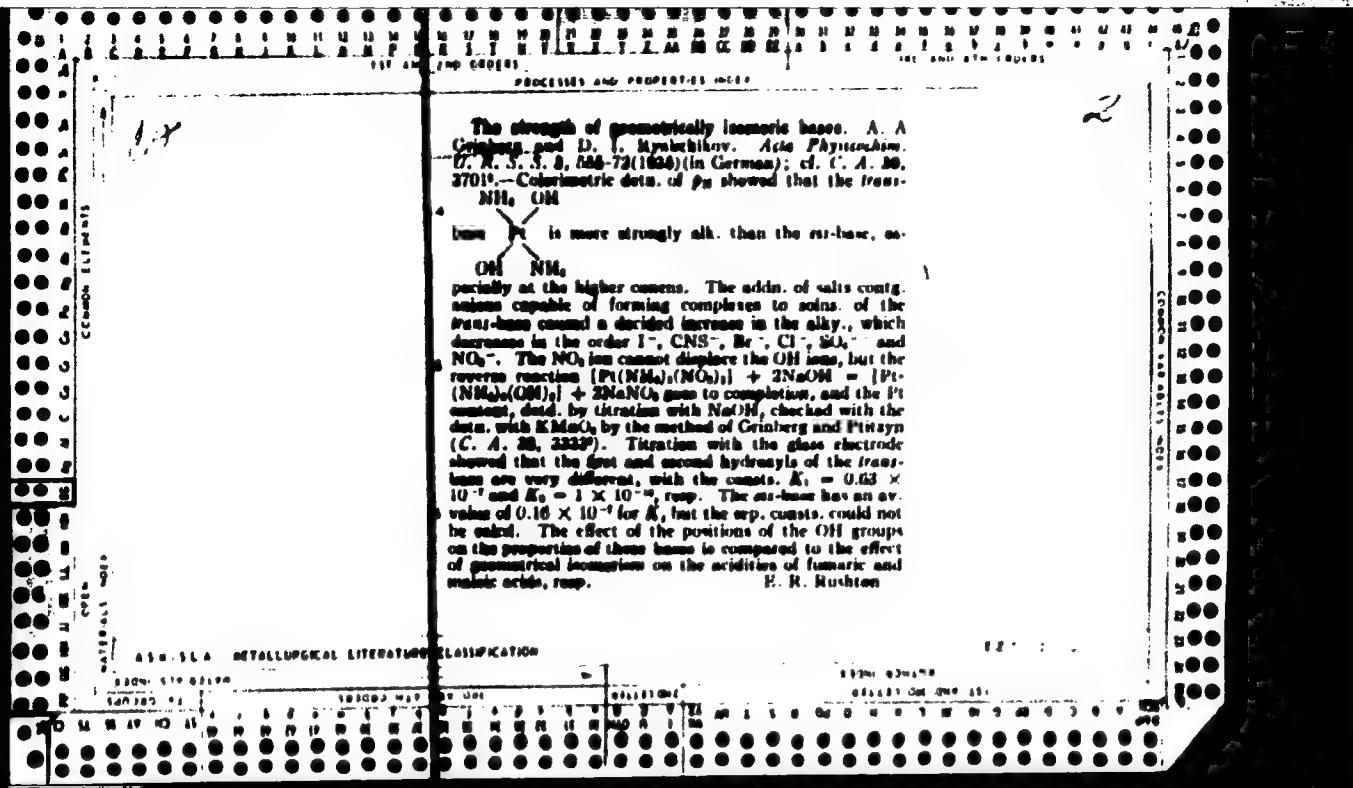
Recent progress in the chemistry of complex compounds
A. A. Grishko. Izv. Akad. Nauk. SSSR, 1973, No. 10, p. 23. - The
structure of complex formation, acidic and
basic properties, and dissociation equilibria of various com-
plexes of transition metal compounds, esp. the substituted NH₃
complexes of Pt, Rh and Ir, are considered. F. H. R.

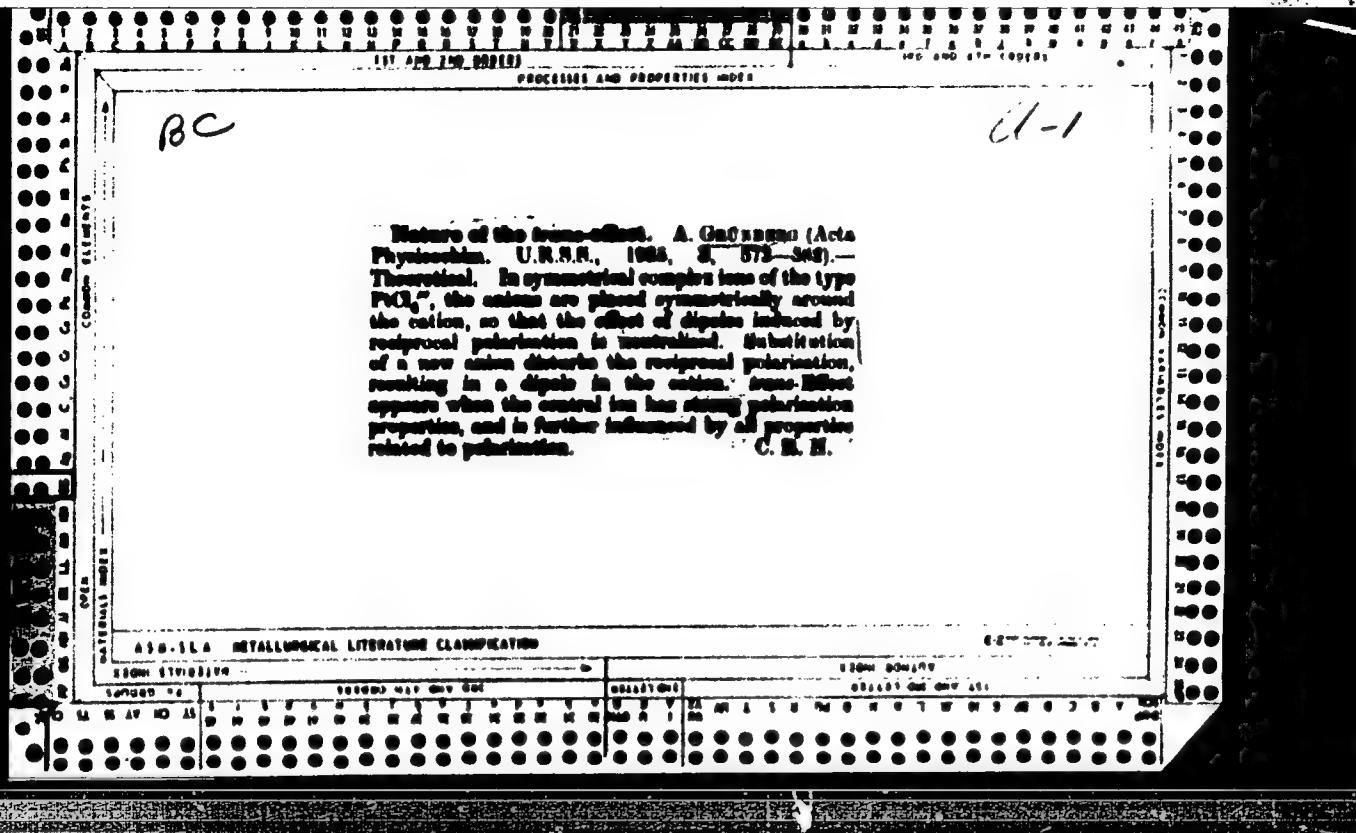
450-314 METALLURGICAL LITERATURE CLASSIFICATION

(A)

The mechanism of the action of glycine on potassium chlorophosphate (potassium tetrachlorophosphate). A. R. S. S. 2, 465 8 (in German 400 01110KA) K₄[P(OH)₃Cl]₄ reacts with glycine to form cis and trans isomers of [14C] (NH₂CH₂COO)₂ in the ratio 1:3. This is counter to the usual case where phosphates react with NH₂ or amines. If the reaction is carried out in a mole, const., sufficient alkali to be equiv. to the carboxyl, the ratio of cis to trans forms is 3:1. It is thought that when the reaction takes place on glycine along with phototetraglycine. The latter compd. then when heated in the presence of H₂O is changed totally into free-glycine, thus giving a high ratio of trans to cis forms. A mechanism embodying this idea is worked out. The phototetraglycines were prepared
C. R. P. Jeffreys

AIR-14A METALLURGICAL LITERATURE CLASSIFICATION





BC

a-1

Synthesis of inorganic bases of the type $[Pt(NH_3)_5(OH)]$. A. A. Gotozino and D. I. Krasnoshchekov. (Khim. i khim. tekhnika, U.R.S.S., 1955, 4, 300-305).—Titration of the cis-compound with 0.1N-HCl at room temp. gives a colour change with blue-red when 60% of the theoretical amount of acid has been added owing to the formation of the weak acid $[Pt(NH_3)_5(H_2O)OH]$. The change $[Pt(NH_3)_5(H_2O)OH] \rightarrow [Pt(NH_3)_5Cl_2] + 2H_2O$ occurs on warming and the theoretical end-point may be attained. The same compound gives an end-point at room temp. corresponding with 80% of the theoretical amount of acid and this is attributed to the formation of $[Pt(NH_3)_5(H_2O)(OH)]Cl$. The final titration val. is obtained on warming. B. S.

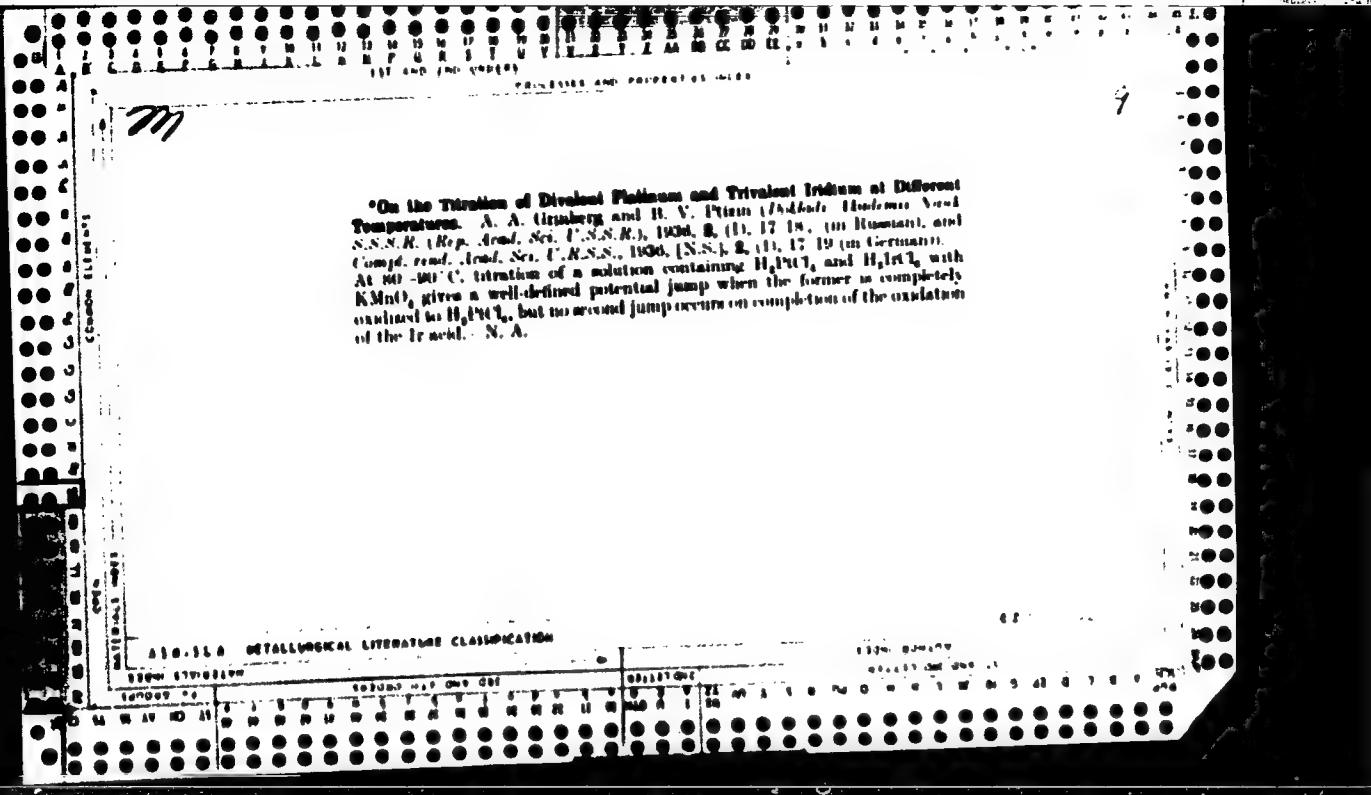
CH
PRECISELY AND PREPARED

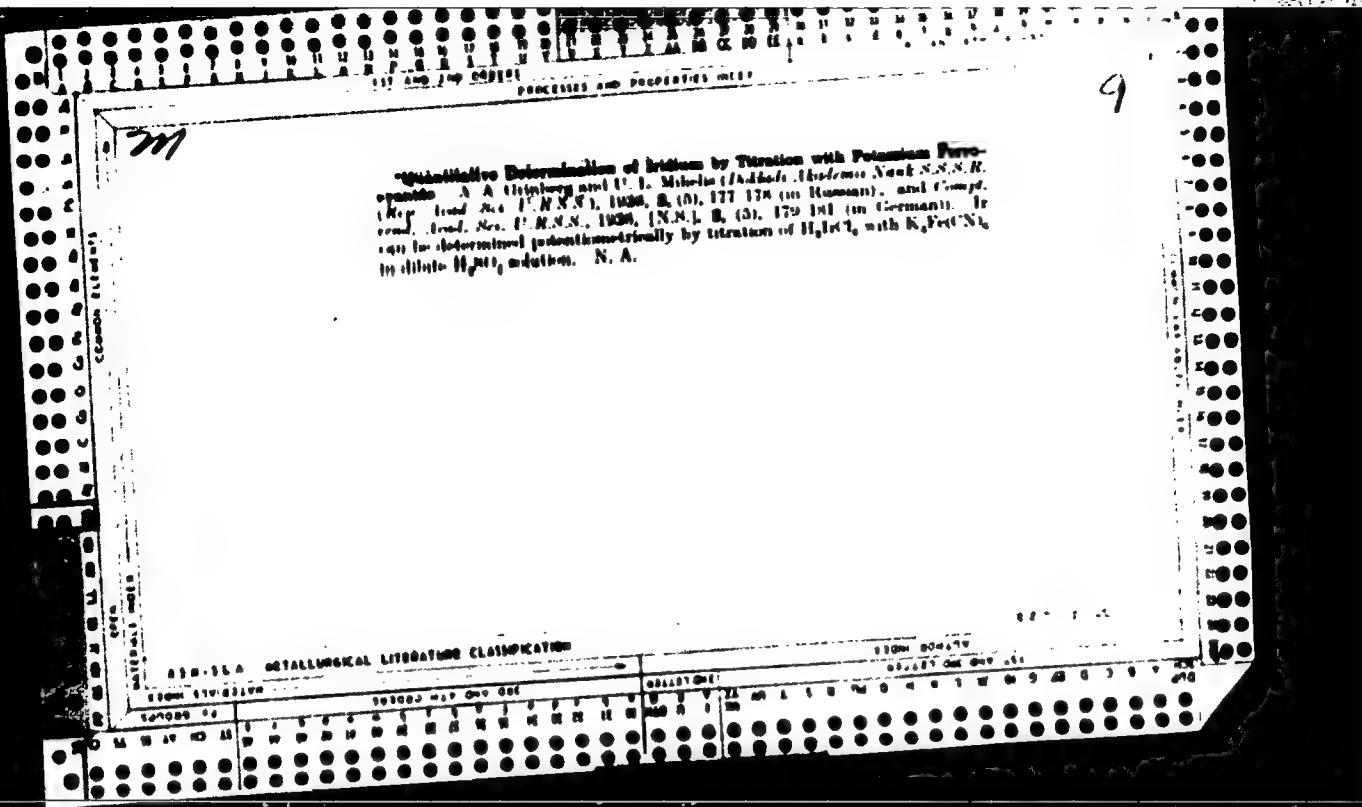
The electrical conductivity of complex compounds of
platinum. A. A. Grinberg, V. M. Shul'man and S. I.
Khorevchenkov. Ann. Phys. Platine (U. S. S. R.) No. 12,
119-32 (1935); cf. C. A. 29, 3331. — The cond's. of K_2PtCl_6 and K_2PtBr_6 are normal when the salts are first
dissolved, but soon rise; this indicates hydrolysis. The
bromide hydrolyzes less than the chloride. $(Pt(NH_3)_6)Cl_2$
and $(Pt(NH_3)_6)Br_2$ are perfectly normal and do not hydrolyze.
However, the bromide slowly decomposes in the
solid form. *Cis*- and *trans*- $(NH_3)_6PtCl_6$ and $(NH_3)_6$

$PtBr_6$, as well as $\begin{array}{c} NH_3 \\ | \\ Pt \\ | \\ O-O-C \end{array}$, which should be
nonelectrolytes, hydrolyze even more rapidly than do the
corresponding Pt compds. The oxalate is the most stable.
The *cis*-bromides hydrolyze more rapidly than do the *trans*-,
and the *trans*-bromides hydrolyze less than do the *trans*-
chlorides. The *cis*-bromides give anomalous results,
because of an isomerization into *trans*-compds. The reac-
tion goes more rapidly in concd. soln. It probably oc-
curs through partial hydrolysis and subsequent replace-
ment of an H_3O^+ by a Br^- in the *trans*-position. This rea-
ction can be explained on the basis of the *trans*-effect, which
also holds for Pt as well as for Pt. H. M. Leicester

ca

The potentiometric titration of platinum and iridium.
A. A. Grinberg and B. V. Pitzman. Ann. Inst. physique
(U.S.S.R.) No. 12, 133-66 (1935); cf. C. A. 28, 2503.
Bivalent Pt can be potentiometrically titrated
with KMnO₄ in H₂SO₄ soln., even in the presence of
quadrivalent Pt. Iodometric reduction of quadrivalent
Pt is unsatisfactory, but Cu₂Cl₂ in HCl soln. can be used
for this purpose. The Pt can then be titrated as above
but in an atm. of Cl₂ to prevent oxidation of the Atm.
The KMnO₄ must be added slowly to avoid oxidation of
the HCl. Trivalent Ir can be detd. in the same manner
as Pt. In this case, visual titration is impossible, owing
to colored solns. Quadrivalent Ir can be reduced to the
trivalent form by (NH₄)₂Pt(SO₄)₂, without any reduction
of Pt compds. The reduction can be followed potenti-
metrically, or the reduced Ir can be reoxidized with
KMnO₄. Cu₂Cl₂ reduces both quadrivalent Pt and Ir in
a mixt. of the two. By using these various reactions most
mixts. of Pt and Ir or of quadrivalent Ir and
bivalent Pt cannot be analyzed by this method. Ir can
be detd. in the presence of Rh. H. M. Lester





Determination of iridium by titration with potassium ferricyanide solution. A. A. Gangberg and I. L. Michlis (*Compt. rend. acad. sci. U. R. S. S. [N. S.]*, 2, 170-81 (1930) (in German); cf. *C. A.* 29, 3623).—In place of t Molar's salt for the potentiometric titration of $(\text{NH}_4)_6\text{Cr}_2\text{O}_7$ soln., $\text{K}_3[\text{Fe}(\text{CN})_6]$ soln. can be used and the results are equally good. W. T. H.

11

7

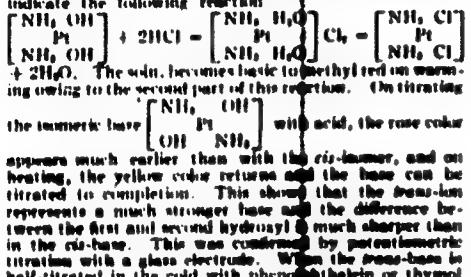
ABN-SEA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051683C

1st AND 2nd ORDERS

STRUCTURE AND PROPERTIES OF

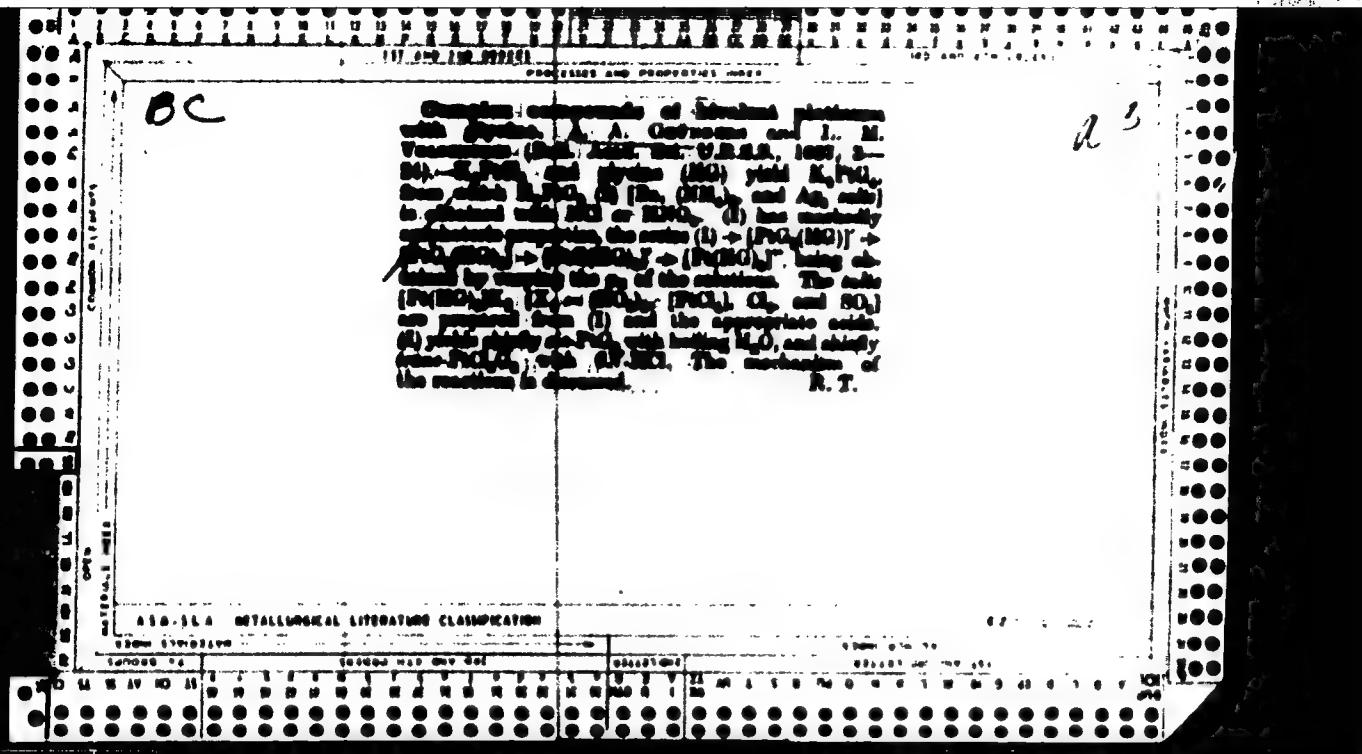
The strength of the isomeric bases of the type $[\text{Pt}(\text{NH}_3)_2(\text{OH})_2]$. A. A. Orinberg and D. I. Ryabchikov. Comp. Acad. Sci. U. R. S. S. (N. S.), 6, 259-62 (1930) (in German).—Titration of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ with 0.1 N NaOH, with phenolphthalein as indicator, gave approx. theoretical results from the amt. of Pt. This is attributed to hydrolysis according to the equation $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2] + 2\text{H}_2\text{O} = [\text{Pt}(\text{NH}_3)_2(\text{OH})_2]\text{Cl}_2 + \text{Pt}(\text{NH}_3)_2(\text{OH})_2 + 2\text{HCl}$. When a soln. of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ is titrated with 0.1 N HCl in the cold, with methyl red as indicator, the rose color appears after the addn. of 60% of the acid theoretically required. When the soln. is heated, it turns yellow again and can be titrated to 100%. With thymol blue, the soln. can be titrated completely. These results indicate the following reaction:



blue, the compd. $\begin{array}{c} \text{OH} \quad \text{NH}_3 \\ | \quad | \\ \text{Pt} \\ | \quad | \\ \text{NH}_3 \quad \text{H}_2\text{O} \end{array} \text{Cl}$ is obtained. This hydrolytic titration can be applied to K_2PtCl_4 in dil. soln. and at the b. p.; otherwise $\text{Pt}(\text{OH})_2$ seps. The color change of the indicator is less pronounced because of the color of the salt.

H. R. Huskton

A50-314 METALLURGICAL LITERATURE CLASSIFICATION



ca

Compounds of bivalent platinum with α -alanine.
A. A. Grinberg and L. M. Volchtein. *Bull. Acad. sci. U.R.S.S. Ser. chim.* 1937, 845-853 (in German 943-5); cf. *C. A.* 35, 2893; 37, 1290; 39, 6600; 38, 7381. - Compds. first studied by Lev and Pickens (*C. A.* 6, 307) included those of α -alanine and glycine. The Pt salt of alanine, PtAn_2 , is obtained in 55% theoretical yield by the reaction: $\text{K}_2\text{PtCl}_4 + 2\text{AnH} \rightarrow \text{PtAn}_2 + 2\text{KCl} + 2\text{HCl}$. The yield could be raised by concn. of filtrate but at the expense of purity. The trans isomer is formed; the cis isomer could not be obtained. PtAn_2 is obtained by adding K_2PtCl_4 to AnH soln. in NaOH , heating the mint., and adding NaNO_3 and KMnO_4 to the $(\text{Pt}(\text{AnH})_2)\text{Cl}_2$ formed. PtAn_2 is very hygroscopic and could not be obtained as a solid. The mixed salt of alanine and glycine, PtAnGly , is prep'd. as follows: $\text{K}_2\text{PtCl}_4 + \text{Gly} \rightarrow \text{PtAnGly} + \text{KCl} + \text{HCl}$. Gly should be 4 times the theoretical quantity. Yield 75-80% theoretical. $\text{PtCl}_3(\text{AnH})_2$ and $\text{PtCl}_3(\text{AnH})(\text{Gly})$ are obtained at 90% theoretical yield by adding concd. HCl to PtAn_2 or PtAnGly . $(\text{Pt}(\text{S:C}(\text{NH}_2)_2)(\text{AnH}))\text{Cl}_2$ and $(\text{Pt}(\text{S:C}(\text{NH}_2)_2)(\text{AnH}))\text{Cl}_3$ are obtained at 65-70% theoretical yield by adding $\text{S:C}(\text{NH}_2)_2$ to $\text{PtCl}_3(\text{AnH})$ (Gly) or $\text{PtCl}_3(\text{AnH})_2$. They are very hygroscopic but after prolonged drying over P_2O_5 are found to contain 2-3% of water. $\text{PtAn}(\text{NH}_2)_2$ and $\text{PtAnGly}(\text{NH}_2)_2$ are obtained by adding NH_2 to PtAn_2 or PtAnGly at 70-80% theoretical yield. Both are highly sol. in water. V. A. Kalshevsky

ASA 56A METALLURGICAL LITERATURE CLASSIFICATION

BL

A-1

Hydrolytic properties of quinolizinium phosphate. II. A. A. Gerasimov and F. M. Pavlov (Sov. Atom. Sci. 1986, 100, 64). China, 197-901. (cf. preceding item).—The compound $(\text{P}_{\text{ANH}_2}\text{Cl}_2\text{O}_4)_n$ (I) has been obtained by hydrolysis of $\text{P}_{\text{ANH}_2}\text{Cl}_2\text{O}_4$ and $(\text{P}_{\text{ANH}_2}\text{OH})_2\text{P}_2\text{O}_7$ (II) in aqueous acid. The compound $(\text{P}_{\text{ANH}_2}\text{Cl}_2\text{O}_4)_n\text{P}_2\text{O}_7$ (III) by reaction of $(\text{P}_{\text{ANH}_2}\text{Cl}_2\text{O}_4)_n$ with P_2O_7 .

With H_3PO_4 (I) yields $(\text{P}_{\text{ANH}_2}\text{Cl}_2\text{O}_4)_n$. On addition of MgCl_2 , no (II) becomes change to (I) occurs, and the $[\text{P}_{\text{ANH}_2}]^+$ and $[\text{P}_{\text{ANH}_2}\text{OH}]^-$ groups during this change unite to form the same salt, which decomposes. The equilibrium $(\text{P}_{\text{ANH}_2})_n[\text{P}_{\text{ANH}_2}] \rightleftharpoons (\text{P}_{\text{ANH}_2}\text{Cl}_2\text{O}_4)_n\text{P}_2\text{O}_7$ exists in solution. The results indicate that if there are present in solution together ions of the same metal having different coordinated groups and different charge constants equilibrium will be established between them, the equilibrium constant being determined by the ratio of the oxidation-reduction potentials of the constituent systems. R. C.

AD-16A METALLURGICAL LITERATURE CLASSIFICATION

Reactions between complex compounds of one metal and the same metal at different valency levels, and the same metal at different valency levels.
A. A. Tikhonov and V. M. Pashkov (Bull. Acad. U.R.S.S., Ser. Chim., 1937, 1263-1264).
The equilibrium, cis- or trans-[Pt(NH₃)₆X]⁺ + K₃[PtX₆] \rightleftharpoons cis- or trans-[Pt(NH₃)₅X]²⁺ + K₂[PtX₆]
is established in the case X = Cl, Br, CN, S, etc.; the
velocity of the reaction rises in the order given.
Compounds of the type cis- or trans-[Pt(NH₃)₅X]²⁺ (X = Br, I) are also
formed in the above reaction. R. T.

Complex compounds of bivalent platinum with glycine.
A. A. Grinberg and L. M. Volokhina. *Bull. Acad. sov. R.S.F.R. Chem.*, No. 1, 3-23 (in German 23-41); cf. *C. A.*, 20, 6049; 21, 3009. — Salts of the type $M_2[Pt(NH_3CH_2COO)_4]$ were prep'd. by addn. of a excess of a neutral glycine soln. to K_2PtCl_4 . In this manner, $Ba_2[Pt(NH_3CH_2COO)_4]$, $Ag_2[Pt(NH_3CH_2COO)_4]$, and the corresponding NH_4 salts were obtained. Theoretical quantities of inorg. acids added to the above salts yield the complex acid $H_2[Pt(NH_3CH_2COO)_4]$ in the crystal state. The latter acid exhibits marked amphiphilic properties unlike those of amino acids. A series of salts containing the cation $[Pt(NH_3CH_2COO)_4]^{2+}$ is described, among which are $[Pt(NH_3CH_2COO)_4]NO_3$, $[Pt(NH_3CH_2COO)_4]Cl$, and $[Pt(NH_3CH_2COO)_4]_2Pt(NH_3CH_2COO)_4$. These salts when treated with H_2O undergo a peculiar change in accord with the equation $[Pt(NH_3CH_2COO)_4]X \rightarrow 2HX + H_2[Pt(NH_3CH_2COO)_4]$. The previously cited bivalent cation behaves as a tetrahedral acid. The values of its acidic constants, are approx. as follows: $A_1 = 4.0 \cdot 10^{-2}$, A_2 between $4.0 \cdot 10^{-3}$ and $4.7 \cdot 10^{-3}$, $K_1 = 4.0 \cdot 10^{-4}$ and the lower limit of A_3 is 10^{-9} . Aq. solns. of $H_2[Pt(NH_3CH_2COO)_4]$ on warming decompose quantitatively into *cis*-diglycine (yield, *cis* form 95.0% and *trans* form 4.5%). On warming with KCl in a soln. of increasing KCl content, the acid undergoes pro-

gressive change with an increasing yield of *trans*-diglycine and a decreasing yield of the *cis* form. The latter change is even more marked when HCl solns. are substituted for KCl . Thus in 6 N HCl , the yield of *trans*-diglycine is quant. With low HCl concns., the action of the latter is entirely catalytic; however, at higher concns. its catalytic effect ceases and the Cl^- deter's the course of the reaction product. A theoretical interpretation of the transformation of tetraglycine into diglycine diene is also included. W. A. Clark

ASSISTANT - DETAILED LITERATURE CLASSIFICATION

Ca

Interaction of complex compounds of the metals with different degrees of valency. A. A. Grishberg and V. M. Filimov. *Bull. acad. sci. U. R. S. S., Classe sci. math., Ser. 37, 2043*. In a spin. of ions of a like metal with unlike valencies and coordination groups there are always formed tautomeric equilibrium, whose constn. are detd. by the correlation between the oxidation-reduction potentials of the corresponding systems (cf. C. A. 31, 38005). A shift of the equil. in corresponding direction can take place in a system forming partly sol. products. On the basis of this theory, the migration processes are considered in the system: $[Pt(NH_3)_6]^{+2} + [PtCl_6]^{-4} \rightleftharpoons [Pt(NH_3)_5Cl]^{+} + [Pt(NH_3)_5Cl_2]^{-3}$. Proceeding from the known oxidation-reduction potentials of the systems $[PtCl_6]^{-4} + 2Cl^- \rightleftharpoons [PtCl_5]^{+} + 2e$, and $[Pt(NH_3)_6]^{+2} + 2Cl^- \rightleftharpoons [Pt(NH_3)_5Cl]^{+} + 2e$, the equil. const. is calc'd. $\lambda = [Pt(NH_3)_5Cl]^{+} / [PtCl_6]^{-4} / [Pt(NH_3)_6]^{+2} = [PtCl_6]^{-4} / 10^{10.7}$ (in 0.1 N HCl at 25°). The migration processes were studied in the systems of the *cis*- and *trans*- $[Pt(NH_3)_5X]_2 + K_2[PtX_6]$ ($X = Cl, Br, I$ and SCN^-). In all these systems the transposition proceeds by the

formula: $[Pt(NH_3)_5X_1] + K_3[PtX_6] = [Pt(NH_3)_5X_1] + K_2[PtX_6]$. Though the oxidation potentials of the bishalogenates decrease in the direction from Cl to I, the conversion velocity of the migration processes of halide systems is greater than that of the chalcide systems with the bromides occupying the intermediate position. This is explained by the greater rate of secondary dissociation in the direction Cl-I, according to the formula: $K_3[PtX_6] \rightleftharpoons K_2[PtX_6] + X_1$. In the systems *trans*- $[Pt(NH_3)_5Br_2] + K_3[PtI_6]$ and cis - $[Pt(NH_3)_5I_2] + K_3[PtI_6]$, in addition to the normal oxidation products, quinhydrone-like metal compounds of the compd. $[Pt(NH_3)_5X_1][Pt(NH_3)_5X_1]$ were isolated. The structure of the compds. of this type is cis - $[Pt(NH_3)_5SCN]_2$ with $K_3[Pt(SCN)_6]$ could be obtained, though the corresponding *trans* compd. gives the normal oxidation product.

APPENDIX B METALLURGICAL LITERATURE CLASSIFICATION

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GRINBERG, H. H.

The oxidation-reduction potentials of the compounds of the platinum metals. I. Oxidation-reduction potentials of the system $[PtX_2]^+ + 2X^- \rightleftharpoons [PtX_4]^{2-} + 2e^-$. A. A. Grinberg, J. V. Filimon and V. N. Lavrent'ev. *J. Phys. Chem.* 31, 818-824 (1927). The oxidation-reduction potential of this system varies very strongly with the nature of the coordinating X^- ion. With respect to the Hg electrode, in 0.01 N solns. of the two Pt salts and 1 N NaX, the E° values at 25° and the heat effects (from temp. coeff.) for various X^- ions are: Cl⁻, 0.758 v.; and -0.2 Cal./deg., 0.013 v.; I⁻, 0.3625 v.; SCN⁻, 0.408 v. These different values are attributed to the different stabilities of the complex ions. K_3PtI_6 was prep'd. by the action of an excess of hot KBr soln. on K_3PtCl_6 in presence of Hg water, and then cooling. K_3PtI_6 was obtained by reduction of K_3PtI_6 with the calcd. amt. of K_2Cd , in presence of Pt black and final recrystn. from EtOH. K_3PtI_6 was prep'd. by boiling K_3PtCl_6 with excess KI. K_3PtI_6 was obtained by slightly warming K_3PtCl_6 in an excess of 1 N KI. $K_3Pt(SCN)_6$ and $K_3Pt(SCN)_5I$ were both prep'd. by the action of warm 1 N KSCN on K_3PtCl_6 and K_3PtI_6 , resp. P. H. Rathmann

The System $CaO-Al_2O_3-P_2O_5-O_2$. Bonaventura Tavaris. Ann. chim. applicata 27, 345-18 (1937). The system CaO-Al₂O₃ was studied by Hansen, Brownmiller and Boggs (C. A. 22, 1223) who limited themselves to the zone high in CaO. In extending the study T. restudied the binary systems involved (C. A. 30, 6450; 31, 8147). The presence of a ternary compd. 4CaO·Al₂O₃ was confirmed. It is completely miscible with 2CaO·FeO

A constituent which was thought to be 4CaO·2FeO was found to be a mixt. of 2CaO·FeO and CaO·FeO confirming Sosman and Merwin (C. A. 10, 2074). A compd. CaO·Al₂O₃ was isolated, whose characteristic property is its complete miscibility with CaO·2FeO. When heated above 1400° it decomps., forming complex oxides among the products formed. A. W. Coulter

BC

Application of oxidation-reduction potentiometric titration to the determination of the composition of complex compounds. A. A. Gal'yanov and D. I. Naumov (Komp. revn. Akad. Nauk U.S.S.R., 1937, 16, 119-122; cf. A. Arad. Nauk U.S.S.R., 1938).--The titration curves for Magnes' green salt in conc. H_2SO_4 and for $Pt(NH_3)_6^{2+}$, with $KMnO_4$ and $KBrO_3$ at room temp. and Re , show one break corresponding with the total Pt. The curve for $[Pt(NH_3)_6]PbBr_6$ in HCl with $KBrO_3$ shows one break in the cold, but two at Re corresponding with the end-points of $[Pt(NH_3)_6]^{2+}$ and $[PtBr_6]^{4-}$. The curve for $[Pt(NH_3)_6]Pt(CN)_6$ with $KMnO_4$ shows break at the end-point of $[Pt(NH_3)_6]^{2+}$ and $[Pt(CN)]^{4-}$. The curve for the isomeric form $Pt(NH_3)_6(CN)_6$ shows one break corresponding with the total Pt.
D. D. S.

Hydrogen compounds of quadravalent platinum.
I. A. A. Gerasimov and P. M. Faznov (Compt. rend. Acad. Sci. U.R.S.S., 1957, 77, 23-27).—Oxidation of K_2PtCl_6 with H_2O_2 in slightly alkaline solution, followed by addition of the neutral hydrochloride of the base, yields p.p.t. of the compounds $(\text{CH}_3\text{NH}_3)_2\text{Pt}(\text{ClO}_4)_2\text{OH}$ (I) (prisms, sparingly sol. in H_2O , readily sol. in acids and alkalies) and $(\text{CH}_3\text{NH}_3)_2\text{Pt}(\text{ClO}_4)_2\text{OH}_2$ (prisms). With $\text{C}_6\text{H}_5\text{N}_3\text{HCl}$, however, the prisms obtained pass rapidly into $\text{c}_{\text{is}}\text{-}\text{Pt}(\text{ClO}_4)_2\text{OH}_2\text{H}_2\text{O}$. The mechanism of this change is discussed. On heating alkaline (I) at 100° for about 1 hr. the white compound turns to brown-orange, this being attributed to formation of $(\text{CH}_3\text{NH}_3)_2\text{Pt}(\text{ClO}_4)\text{OH}$. On mixing K_2PtCl_6 oxidized by H_2O_2 with HgCl_2 , the compound $\text{Hg}[\text{Pt}(\text{ClO}_4)_2\text{OH}_2]$, insol. in H_2O but readily sol. in HgCl_2 , is obtained. J. W. S.

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